February

25 cents

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

THE STELLAR EXPRESS

See Page 952

PARTS — ACCESSORIES — SETS

"FOR THE FAN" FOR EVERYONE FOR BUSY PEOPLE

QUALITY APPARATUS AT LOW PRICES

WE PAY THE EXPRESS OR POSTAGE IN UNITED STATES AND U. S. POSSESSIONS
Except Storage "A" Batteries
YOUR ORDER—SMALL OR LARGE—FILLED THE DAY RECEIVED

VACUUM TUBES

Genuine Cunningham Tubes made by the General Electric Co. Every tube guaranteed new and in original package. We do not sell "bootleg" tubes.

J-C200—Detector $4.40
J-C201—Amplifier ... 5.90

METAL AND BAKELITE SOCKETS

Bakelite brown finished socket for panel or base mounting. Double spring contacts held tightly in place.

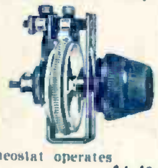
J1076—Bakelite socket. $0.65
J1075—Nickeled metal socket .... .45

VACUUM TUBE RHEOSTATS

This is a reasonably priced, smooth acting rheostat that will mount directly on back of panel. Bakelite arrow knob.

J1050—Rheostat 45c

Genuine Cutler Hammer rheostats, we believe, are the best rheostats on the market today. Arranged for panel mounting. The picture shows the vernier type. All metal parts nickeled.



J1061—Vernier type C. H. Rheostat $1.40
J1062—C. H. Rheostat without vernier. .95
J1064—Howard vernier rheostat operates from one knob $1.40
J1065—Howard rheostat without vernier. .90

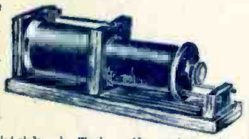
VARIABLE GRID LEAK

Pencil mark type. Removable black enameled cap.
J50—Grid Leak 22c

GRID AND PHONE CONDENSERS

Mounting holes spaced to fit screws of above Grid Leak. Mica insulation, wrapped with varnished cambric tape. Capacity. .00025 Mfd.
J55—Grid Condenser 18c
J59—Phone Condenser .001 Mfd. 25c

LOOSE COUPLER AND TUNING COIL



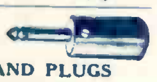
This loose coupler is preferred by many because of its wide range — 200 to 3500 meters. Mahogany finish. All metal parts are brass, nickeled and highly buffed. Secondary has 12 point switch mounted on Bakelite coil head. Windings are green silk-covered wire.
J800—Size, 5½x6x18 inch $6.50
J805—Two Slide Tuning Coil 2.60

CRYSTAL DETECTOR

A very high grade glass enclosed crystal detector including the crystal. All metal parts nickel plated. Adjustable to any point on the crystal.
J20—Enclosed crystal detector $1.30
A lower priced but nicely constructed detector. Crystal included.
J30—Detector .... .88

TESTED CRYSTALS

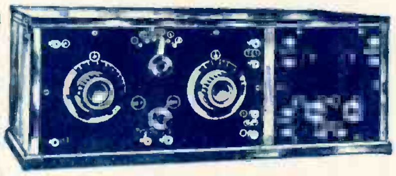
Selected and tested galena or silicon. Each box contains enough for four to six ordinary crystals.
J12—Galena, per pkg. .$0.10
J13—Silicon, per pkg. .. .10



FROST JACKS AND PLUGS

Jacks are polished nickel, nickel-silver springs, pure silver contacts. Nickel washers for mounting on any panel ⅛ to ⅜ inch thick. Spread terminals make soldering easy.
J133—One spring (open circuit). Each $0.46
J134—Two spring (closed circuit). Each .52
J131—Four spring (two closed circuits) Each .... .63
J135—Three spring (two open circuits, commonly called "single circuit filament control"). Each .... .70
J136—Five spring (two open and two closed circuits, commonly called "two circuit filament control"). Each .... .88
J132—Plug, telephone type with short knurled grip .... .35
J137—Plug (as shown), cord tips fit into plug 1.05
J139—Plug with threaded barrel instead of set screw. Takes cord tips .... .55

LICENSED REGENERATIVE RECEIVING SETS



Licensed under Armstrong Patents. Solid Mahogany case, hinged cover, shielded Bakelite panel and parts mounted on panel. Wide range, 150-800 meters.

The JT225, is a complete receiving set with detecting unit—and two stages of amplification as pictured above. The JT224, consists of complete tuning and detector unit in shorter cabinet (see division of panel). Ideal sets for concert reception. Tubes, batteries, etc., are always sold separately. Order from us and save money.

JT225—Tuska Receiving, Detector and two stage Amplifier Set $59.50
JT224—Tuska Popular Receiver and Detector Set 31.50
JT226—Tuska Two Stage Amplifier for JT224 .... 36.00

OUR GUARANTEE
Your satisfaction guaranteed. If for any reason you do not feel satisfied with your purchase, you may return it and we will refund your money. We will pay return transportation charges.

PHONES

Genuine Frost and Brandes head sets complete with cords.
Frost J162—Double head sets, 2000 ohm. $4.25
Frost J163—Double head sets, 3000 ohm. 4.90
J168—Western Electric latest type double head set. List $12.00. Our price 10.50
Brandes Superior J166—Double head sets, 2000 ohm 7.20

"B" BATTERIES

Standard high-grade radio "B" batteries. Never over five days old.
J230—22½ volt Signal Corps type. Size 3⅛x2x2¼ inch $1.08
J235—22½ volt U. S. Navy variable—5 positive taps. Size, 5x3x2½. Price $1.80
J240—22½ volt large variable—5 positive taps. Size 6½x4x3. Price 2.25
J245—45 volt large leads only. Size, 13x4x3. Price 4.00

INDUCTANCE COILS

Rigidly wound, nicely finished, low distributed capacity. All coils are equipped with standard mountings. We can supply any of these coils without mounting plugs, for 55c less than the prices shown. The wave lengths shown are range limits, based on a variable condenser of .001 Mfd. capacity.

	Number of Turns	Wave Lengths	Price Mtd.
J1725	25	125- 250	$0.95
J1726	35	175- 450	0.98
J1727	50	240- 720	1.05
J1728	75	390- 910	1.10
J1729	100	500- 1450	1.14
J1731	200	900- 2500	1.28
J1732	250	1200- 3500	1.36
J1733	300	1500- 4500	1.38
J1735	500	2800- 6100	1.65
J1737	750	5000-12000	1.95
J1738	1000	7900-15000	2.30
J1739	1250	9750-19500	2.55
J1740	1500	14500-26500	2.70

STORAGE "A" BATTERIES

Built of entirely new parts. With the proper care they should last several years. The De Luxe type has rubber case and cover for top as pictured, the Standard type has black wood case similar to ordinary automobile type. Guaranteed to give full rated capacity. All 6 volt batteries.

Number	Amp. Hour Rating	Shpg. Wgt.	Price
JD 60—De Luxe....	60	40	$15.50
JD 80—De Luxe....	80	50	17.50
JD100—De Luxe....	100	62	20.50
JS 60—Standard ...	60	35	12.25
JS 80—Standard ...	80	40	14.25
JS100—Standard ...	100	50	16.25
JS110—Standard ...	120	60	18.25

The above storage batteries are the only items on which we do not pay transportation charges. We will ship by Express.

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

There is probably no better known transformer. Made by a company that specializes in transformers. Entirely encased in sheet aluminum shield. Heavy connecting straps to binding posts.
J1504—Thordarson Transformers, 3½ to 1..$3.65
J1505—Thordarson Transformer, 5½ to 1 $4.20

AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

Correctly designed for minimum distributed capacity and low core loss. Shielded, beautifully finished in nickel and black enamel. Ratio 5½ to 1.
J1506—Shielded Transformer $3.75
The unshielded types listed below have terminals mounted on Bakelite panel. Two ratios.
J1510—Transformer, 10 to 1 ratio....$3.55
J1503—Transformer, 3 to 1 ratio.... 3.50

RADIO FREQUENCY AMPLIFYING TRANSFORMERS

Radio frequency transformer circuits help to eliminate static and interference, thus permitting easy, sharp tuning of long distance stations. Enclosed in metal case for shielding and can be mounted in tube socket if desired. Wiring diagrams furnished with each transformer.
J1500—Transformer. Each $3.47

INDUCTANCE COIL MOUNTINGS

For base or panel mounting. Connecting leads furnished, coil settings are adjustable by means of knobs. Made entirely of bakelite with nickeled brass metal parts. Coil position can be locked by knurled set screws.
J1603—Three coil mounting........ $3.50
J1602—Two coil mounting........ 2.75
J1601—Single coil mounting........ .50

BINDING POSTS

Complete with screw and washer. All brass, finished in polished nickel or with black composition top as listed. Order by number.

	Each	Doz.
J110—Large size, all nickeled	10c	95c
J122—Medium size, nickeled, with hole for phone tip or wire.	4c	35c
J112—Medium size, black composition top	5c	48c
J120—Large size, composition top..	8c	85c

SWITCH POINTS AND STOPS

Brass, polished nickel finish. Screw size, 6-32x5-8 ins. long, two nuts with each contact point and one with the stops. Stops high enough for any type of lever and point.

	Each	Doz.	Hundred
J130—Switch Point, diam., ¼ inch; height 3-16 inch..........	3c	20c	$1.40
J150—Switch Stops..	3c	20c	1.40

SWITCH LEVERS

A high grade, polished nickel-plated lever with solid moulded black composition knob. Complete with panel bushing, spring and two nuts.

	Each	Doz.
J151—1-in. Radius	20c	$2.25
J152—1¼-in. Radius	20c	2.25
J155—1½-in. Radius	20c	2.25

VARIOMETERS

For efficiency, perfect inductive ratio, low capacity effect and neatness of design these variometers are unexcelled. All metal parts nickeled brass. Stator and ball mahogany finish. Furnished completely assembled and tested.
J1300—Variometer, No. 18 wire...... $2.75
J1200—Variometer, No. 20 wire...... 2.75
The following knocked-down variometers have the stator windings wound and cemented ready to put in place. Two sizes of wire as listed. Complete with wire and metal parts.
J1205—Knocked-down variometer with No. 20 wire........ $1.85
J1305—Knocked-down variometer with No. 18 wire........ 1.85

180° VARIOCOUPLER

The primary and secondary windings of this coupler are properly proportioned and spaced. The center of the secondary is always in the center of the primary field. Unlike most couplers, it aids in tuning. Black fibre base, brown formica tube, and nickeled metal parts. Panel or table mounting.
J1100—Coupler $2.95

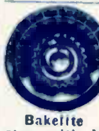
VARIABLE CONDENSERS

Very best mechanical construction. Heavy, hard aluminum plates. The vernier types are furnished with moulded dial and small knob for adjusting vernier. Plain types have ¼ inch shaft.
J1443—43 plates .001 Mfd. without dial. $2.35
J1423—23 plates .0005 Mfd. without dial 1.80
J1411—11 plates .0025 Mfd. without dial 1.35
J1403—3 plates .00005 Mfd. without dial 1.15
J1441—41 plates vernier .001 Mfd. with dial 4.95
J1442—21 plates vernier .0005 Mfd. with dial 4.25

THORDARSON VERNIER CONDENSERS

J1523—23-plate vernier .0005 Mfd. with knob and dial........ $3.65
J1543—13-plate vernier .001 Mfd. with knob and dial........ 4.35

DIALS



Bakelite   Composition

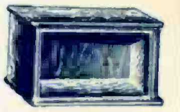
Genuine Bakelite Dial as pictured. Sharply engraved divisions and figures filled with a brilliant white. Three-inch diameter, with bushing for 3-16-inch or ¼-inch shaft. Set screws included.

	Each	Doz.
J500—Dial	60c	$7.00

Three-inch moulded composition dial as pictured. Has a luster that cannot be told from Bakelite. Set screws included.

	Each	Doz.
J550—Dial, 3-16-in. Shaft.....	30c	$3.00
J555—Dial, ¼-in. Shaft.....	30c	3.00

CABINETS



These are reasonably priced but sturdily built cabinets of weathered oak. The top is removable by loosening four screws. End posts are routed to take panel 3-16 inch thick. The panels are not included. See table for panel lengths.
J212—Can be used for detector and two step. Panel space, 5⅛x12........ $2.50
J214—Can be used for 2 variometers and 1 coupler. Panel space, 5½x14........ 2.75
J218—Can be used for 2 variometers 1 coupler and detector. Panel space, 5½x18 3.00
J222—Can be used for 2 variometers, 1 coupler, detector and 2 step. Panel space, 5½x22........ 3.25

PANELS

Genuine Formica. Panels to fit our cabinets.
J262—Panel, 5½x12-in. 3-16-in. thick. $1.30
J264—Panel, 5½x14-in. 3-16-in. thick. 1.64
J268—Panel, 5½x18-in. 3-16-in. thick. 2.08
J272—Panel, 5½x22-in. 3-16-in. thick. 2.53

SPAGHETTI AND WIRE

For cabinet wiring. Yellow finish spaghetti.
J33—Per 4-ft. length........ 27c
J32—Tinned Copper No. 16 Wire... Ft. 2c
20 Ft. 30c
J33—Wire with insulation similar to spaghetti on it. Wire is tinned for soldering. Price, 10 feet........ 37c

INSULATORS

These are very strong strain type insulators

	Each	Doz.
J360—Moulded insulator shown	$ .10	$1.10
J365—Porcelain insulators.....	.09	.95

ANTENNA WIRE

The following are 100 foot coils of 7 strand cable of No. 22 wire, which makes the best Aerial. Use phosphor bronze, where the span is 100 feet or more. It is stronger.
J350—Stranded Phosphor Bronze, 100 ft. $1.47
J355—Stranded Copper, 100 ft....... .77
J356—Single No. 14 bare solid Copper Wire, 100 ft........ .42

LIGHTNING ARRESTER or PROTECTOR

Mounts indoors. Porcelain base, nickeled cover. Listed by the Underwriters' Laboratories under April, 1922, regulations.
J300—Protector $1.40

HOW TO ORDER
Order from this page. Please give number, description and price of the articles you order to help us avoid mistakes. Total the amount of your order and send Post Office money order, certified check or draft with your order. Be sure to give your name and street address on both letter and envelope. Do not include money for transportation. We pay it except on storage "A" batteries. See ads of previous months for other items.

GREAT LAKES RADIO CO., 1124 JACKSON BOULEVARD CHICAGO, ILL.

Vol. X
Whole No. 118

Science and Invention

February, 1923
No. 10

FORMERLY
ELECTRICAL EXPERIMENTER

PUBLICATION OFFICE: 542 Jamaica Ave., Jamaica, N.Y.
EDITORIAL & GENERAL OFFICES: 53 Park Place, New York City

Published by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y).
Publishers of SCIENCE AND INVENTION, RADIO NEWS, and PRACTICAL ELECTRICS

Table of Contents for February

POPULAR SCIENTIFIC ARTICLES

EDITORIAL 945
STAGE MAKES DWARFS OF US ALL 946
POLY-LINGUAL TYPEWRITER 946
By Roland D. Johnson
HOW MUCH GOLD HAS BEEN MINED 947
By Charles Nevers Holmes
WORLD'S LARGEST PHOTO ON MOUNTAIN 948
By Carl Taylor
ARTIFICIAL SILK—HOW MADE 949
By Samuel Wein
OSCILLATORY POWER—THE TICKLESS CLOCK 951
By Dr. Alfred Gradenwitz
NAVIGATING INTERSTELLAR SPACE 952
By Charles Frederick Carter
THE NEW ACCELERATOR 954
By H. G. Wells
DR. HACKENSAW'S SECRETS—No. 13—THE SECRET OF THE ARTIFICIAL GILLS 956
By Clement Fezandié
RADIO CONTROLLED MYSTERY SHIP 957
By Graser Schornstheimer, Naval Expert
CAUTIONS BURNERS OF OIL IN HOUSES 957
A GIANT WIND POWER PLANT 958
REAL SNOW STORMS FOR THEATRES 959
NOVEL FRENCH REVOLVING STAGE 960
THE SECRET OF THE OLD ITALIAN VIOLINS 961
By Dr. Albert Neuburger
AN AMPHIBIOUS BATTLE TANK 962
By A. P. Peck
LIGHT EFFECTS IN THE THEATRE 963
By Lucien Fournier, Paris Correspondent
THE GEOMETRY OF THE EYE 964
By Dr. Ernest Bade
FROM OCEAN DEPTHS TO MOUNTAIN HEIGHTS 965
By Charles Nevers Holmes
NEW MUSIC STAFF 965
THE LATEST IN COLOR HARMONY 966
By William R. Reinicke
DANCER'S TOES LIGHT COSTUME 967
GREAT MOVIE SCENE IN SMALL SPACE 967
By Dr. Albert Neuburger
THIEF-TRAPPING BOOTH FOR BANKS 968
A NEW BULLET-PROOF VEST 968
HOW MOSQUITOES SPREAD MALARIA 969
By Charles Frederick Carter
POPULAR ASTRONOMY 970
By Isabel M. Lewis, M.A., of the U. S. Naval Observatory
SCIENTIFIC PROBLEMS AND PUZZLES 971
By Ernest K. Chapin
THE AMATEUR MAGICIAN 973
By Joseph H. Kraus

PRIZE CONTESTS

MOTOR HINTS—$50.00 IN PRIZES MONTHLY 972
HOW-TO-MAKE-IT DEPARTMENT—$30.00 IN PRIZES MONTHLY 980
WRINKLES, RECIPES, AND FORMULAS—Edited by S. Gernsback 981
HONORABLE MENTION AWARDS IN THE $300.00 SIMPLEST RADIOPHONE RECEIVER CONTEST. 983

AUTOMOBILES

MOTOR HINTS—$50.00 IN PRIZES MONTHLY 972

ELECTRICITY

A GIANT WIND POWER PLANT 958
NOVEL FRENCH REVOLVING STAGE 960
LIGHT EFFECTS IN THE THEATRE 963
By Lucien Fournier
DANCER'S TOES LIGHT COSTUME 967
MOTOR HINTS—$50.00 IN PRIZES MONTHLY 972
THE AMATEUR MAGICIAN 973
By Joseph H. Kraus
EXPERIMENTAL ELECTRO-CHEMISTRY 976
By Raymond B. Wailes
WIND-DRIVEN ELECTRIC LIGHTING SYSTEM 977
By L. B. Robbins
HOW-TO-MAKE-IT DEPARTMENT—$30.00 IN PRIZES MONTHLY 980
LATEST PATENTS 992
THE ORACLE—QUESTION AND ANSWER BOX 993
PATENT ADVICE—Edited by Joseph H. Kraus 1015

RADIO ARTICLES

RADIO CONTROLLED MYSTERY SHIP 957
By Graser Schornstheimer, Naval Expert
MOTION PICTURES VIA RADIO 982
By Joseph H. Kraus
HONORABLE MENTION AWARDS IN THE $300.00 SIMPLEST RADIOPHONE RECEIVER CONTEST. 983
NEW AND ODD USES FOR AUDION AMPLIFIERS 985
By H. Winfield Secor
STORAGE "B" BATTERIES 986
BROADCAST STATION PHOTOS 988
BROADCAST RADIOPHONE STATION CALL LETTERS UP TO DATE 989
RADIO FOR THE BEGINNER—No. 12—SELECTIVITY 990
By Armstrong Perry
RADIO ORACLE 991

CHEMISTRY AND ELECTRO-CHEMISTRY

PRACTICAL CHEMICAL EXPERIMENTS 974
By Prof. Floyd L. Darrow
EXPERIMENTAL ELECTRO-CHEMISTRY 976
By Raymond B. Wailes
WRINKLES, RECIPES, AND FORMULAS—Edited by S. Gernsback 981
BRASS ETCHING 986
THE ORACLE—QUESTION AND ANSWER BOX 993

CONSTRUCTOR ARTICLES

WIND-DRIVEN ELECTRIC LIGHTING SYSTEM 977
By L. B. Robbins
HOW TO USE YOUR CAMERA 978
By Dr. Ernest Bade
MISSION LIBRARY LAMP 979
HONORABLE MENTION AWARDS IN THE $300.00 SIMPLEST RADIOPHONE RECEIVER CONTEST. 983

ASTRONOMY

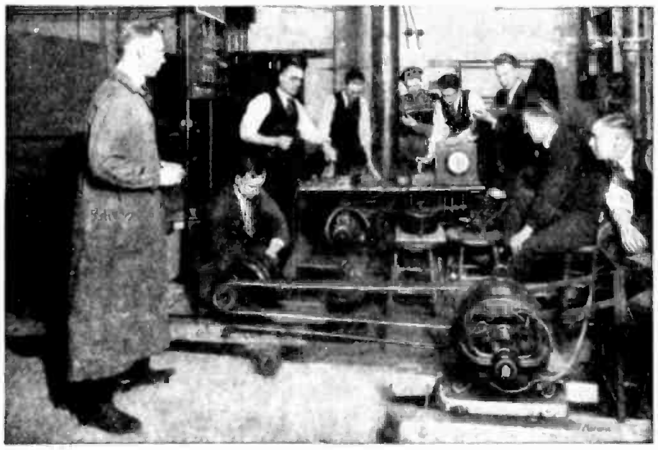
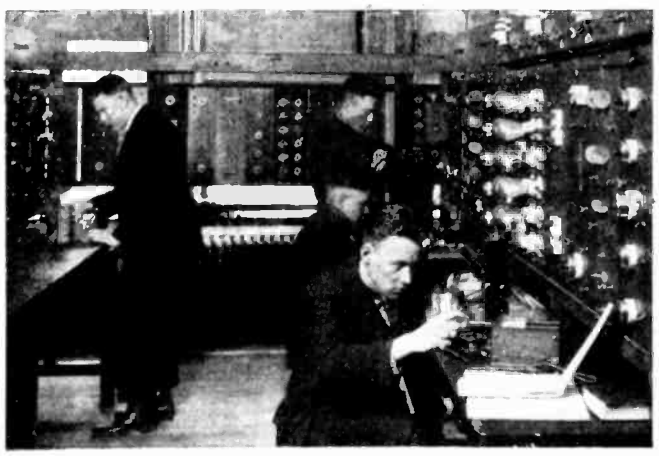
POPULAR ASTRONOMY 970
By Isabel M. Lewis, M.A.
NAVIGATING INTERSTELLAR SPACE 952
By Charles Frederick Carter

SCIENCE AND INVENTION is published on the 25th of each month. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries $3.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addressed to Editor, SCIENCE AND INVENTION, 542 Jamaica Avenue, Jamaica, New York, or 53 Park Place, New York City, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at Jamaica, N. Y., Post Office, under act of Congress of March 3, 1879. Title registered at the Patent Office.

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.

YOU CAN BECOME A COMMERCIAL ELECTRICAL ENGINEER IN ONE YEAR

Unparalleled opportunities for brilliant, successful careers in the new field of Commercial Electrical Engineering. To meet the extraordinary present-day demand for trained electrical men.

"Earn While You Learn"

We agree to provide, for a limited number of worthy young men, half-time jobs at good wages, and permanent positions with unlimited prospects to all duly qualified graduates. **Here is the opportunity of your life** to acquire a thorough, practical training for big-paying profession that is in urgent need of trained men.

COMMERCIAL ELECTRICAL ENGINEERING

COMPLETE COURSE IN ONE YEAR

A Commercial Electrical Engineer is a man who combines the practical application of sound business training with skilled Electrotechnical knowledge. He is a technically trained business man—a salesman—a consulting engineer—an electrotechnical expert and emergency man all in one. He's a sales-engineer and an engineer-salesman—a professional man and an executive—an outside man and an inside man. He's one of the **big men** in a business organization. He draws big pay. He's practically his own boss—he fixes his own hours of work.

Included in your course of instruction are such practical applied subjects as **Scientific Salesmanship, Commercial Law and General Business Practice**, Merchandising, Public Relations, Engineering Relations, **Industrial Chemistry, Mechanical Drafting, Machine Design,** and a thorough systematic and practical training in **Applied Electricity** and **Electrical Engineering**, including Power Plant Engineering, Illumination and Street Lighting, Industrial Application of Electricity, Direct Current Apparatus and Machinery, Alternating Current Apparatus and Machinery.

Young men with a diploma from an accredited high school will finish this complete Commercial Electrical Engineering course in one year. Students with a grade school education may finish our Electrotechnician and Commercial Electrical Engineering courses in from one to two years. **You may "Earn While You Learn"** if you like, and attend classes half-days and secure, with our assistance, employment for half-days. If your means are limited, you may begin with the Practical Electrical Education, and after securing your diploma as a Master Electrician in six months, go to work and save your money so you can complete your Commercial Electrical Engineering course.

Established 17 years ago, the School of Engineering of Milwaukee stands absolutely alone in the field of thorough, practical education in the field of electrical and commercial engineering—has the emphatic and unqualified endorsement of leading engineers and the U. S. Government, which established with us a Student Army Training Corps in 1918.

No need of your being without an S. of E. training. It does not matter how old you are or what schooling you have had. Students from 16 years up to 50 are in attendance here.

Write at once for New Illustrated Catalog (just off the press) and full particulars.

Join either February 19th or April 2nd term. BUT get full details TODAY. Clip the coupon. Mark X before course interested in.

SCHOOL of ENGINEERING of Milwaukee

Dept. S.I.-223

415 Marshall St. Milwaukee, Wis.

THE DEMAND FOR COMMERCIAL ELECTRICAL ENGINEERS

There is a great and definite demand on the part of the business and industrial world for engineers of broad capacity—for business men with technical knowledge—for technical men with business knowledge. Engineers who have a broad viewpoint of life in general and of business in particular, are in great demand—engineers who are able to bring to the service of their associates, and especially their clients, a sound technical training combined with a knowledge of human nature and of the principles and methods pursued in every-day business life. A commercial engineer is, first and last,—an engineer. His thorough knowledge of technical matters places him on a different and higher plane than that occupied by the commercial man of former days. His technical training enables him to talk or write intelligently on matters pertaining to machines, apparatus, instruments, etc., the technical characteristics of which are entirely familiar to him and this concrete knowledge of engineering matters assures him success in his commercial activities. The young man who has the natural inclination for transacting business and the faculty to deal with the business world and to establish good personal relationships, is qualified to become a commercial electrical engineer.

TEAR OFF COUPON HERE

SCHOOL OF ENGINEERING OF MILWAUKEE,
Dept. S.I.-223, 415 Marshall Street, Milwaukee, Wis.

Please send, without obligation on my part, details of your Commercial Electrical Engineering Course.

Name ....

Address ....

City .... State ....

Age .... Education ....

(Mark any other Course Interested in with X).

....Electrical Engineering ....Electrotechnics

....Automotive Electricity ....Drafting

Practical Electricity

....6 mo. Complete Course.

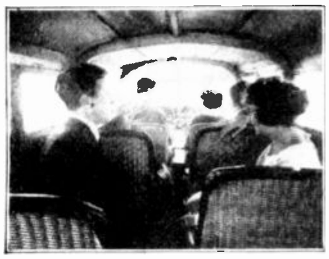
....3 mo. Armature Winding Course.

....3 mo. Light and Motor Wiring Course. S.&I.

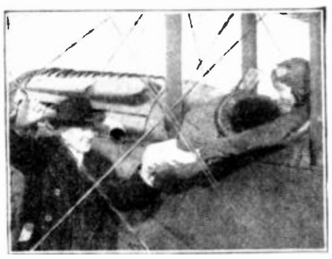
Go as High as You Like
No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men. Many more trained men will be needed to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in Aviation and you have an advantage because you can be trained before you start.

Delivering Newspaper "Extras" by Airplane



A New Seven-Passenger Airplane



A New Job—The Aerial Postman

View in an Airplane Factory

Thousands of Airplane Mechanics will be Needed

The airplane industry is going forward by leaps and bounds. Transportation—passenger carrying and mail carrying lines are being opened up everywhere. This means men—men—men! Trained men only are wanted—men who know what's what. Get ready now to make big money. The industry is calling for real red-blooded fellows—heed the call—*now* is the time to get started—while the industry is still in its infancy.

Here Are a Few Jobs That Will Pay $50.00 to $250.00 a Week:

Aeronautical Instructor, Aeronautical Engineer, Aeronautical Contractor, Airplane Repairman, Airplane Mechanician, Airplane Inspector, Airplane Salesman, Airplane Assembler, Airplane Builder

Learn at Home In Your Spare Time

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man who can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc. Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.

Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

American School of Aviation
Dept. 7432 3601 Michigan Ave., Chicago

Mail This Coupon For FREE BOOK

AMERICAN SCHOOL OF AVIATION
Dept. 7432
3601 Michigan Ave.
Chicago

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

Name...

Address...

City...State.................

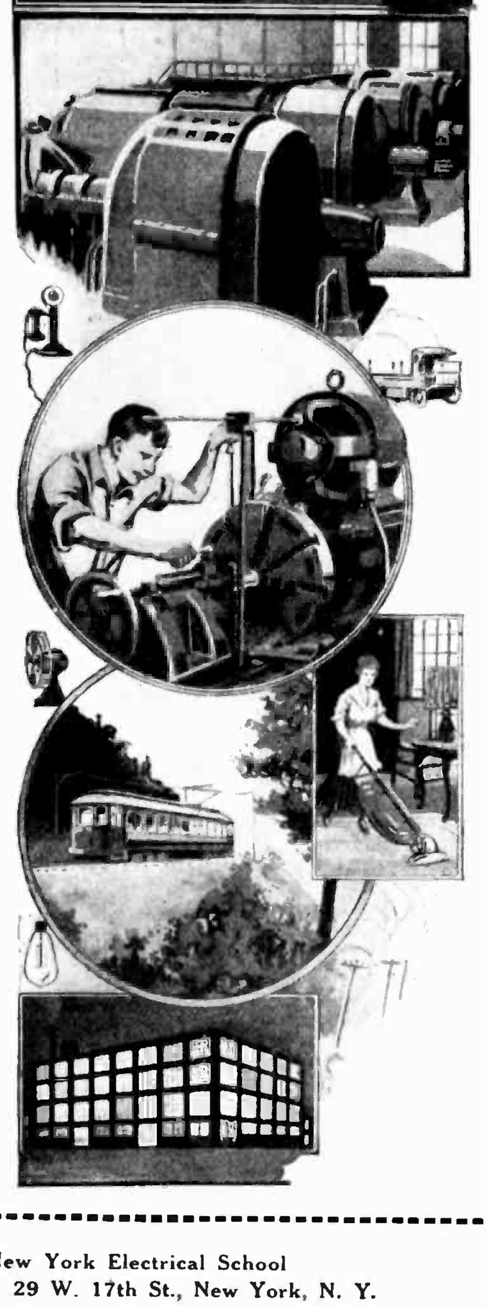
Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing*. That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business methods and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.



Over 8,000 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

The N. Y. E. S. gives a special Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

Let us explain our complete courses to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

.... NAME
.... STREET
................CITY .... STATE

New York Electrical School

29 West 17th Street, New York

Volume X
Whole No. 118

Science and Invention

H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., ASSOCIATE EDITOR
Editorial and General Offices, - - - 53 Park Place, New York

FEBRUARY
1923
No. 10

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact"--HUXLEY

Popular Misconceptions

ONE of the most mischievous things is probably Habit. A friend comes up to you and tells you a certain thing which he believes to be a fact. He says the same thing to another acquaintance, and sooner or later this acquaintance will mention the same thing, which he also believes to be a fact, to you. You perhaps hear the same statement from four or five sources, and you believe it. The belief becomes a habit with you, quite unthinkingly, and sooner or later it becomes imbedded in your mind as a truth, although there is, perhaps, not the slightest foundation for the belief.

Our lives are full of such beliefs and misconceptions, and if we were to analyze all of these hearsay statements, we would be very much astonished. It takes a scientist to find out, and point out, such misconceptions. Here are a few, brought out at a recent meeting of the American Association for the Advancement of Science:

For instance, you say that a red cloth waved in front of a bull will stir him to a frenzy. This belief, however, is not based upon actual fact. Waving a red rag at a bull will not excite him any more than waving any other bright colored cloth in front of him. What DOES excite him seems to be the sudden flutter of any color, which startles the bull. As a matter of fact, the bulls under observation seemed to be more excited by white flags than by red.

Another misconception is that earthquakes have to do with volcanic activities. This belief is not based upon truth. Rather, earthquakes are due to the combined tidal action of the sun and the moon. We all know that the level of the ocean is changed by the tides. The water rises and falls because there is not very much resistance to it. The earth crust, moreover, is subject to exactly the same forces, but does not yield so readily as does the water, and only yields where there are the so-called "faults" or weak strata in the earth's crust. The amount of yielding of the rigid earth to the gravitational action between itself and the sun and moon has recently been measured exactly by the well-known physicist, Dr. A. A. Michelson, of Chicago.

Another misconception is that continuous shaving of the human hair makes this hair stiff and wiry. There is no foundation for this belief. Actual tests, which have been made by growing beards on men who had shaved for as long as forty years, brought out the fact that such hair was not any stiffer than the beards of men who had never shaved at all.

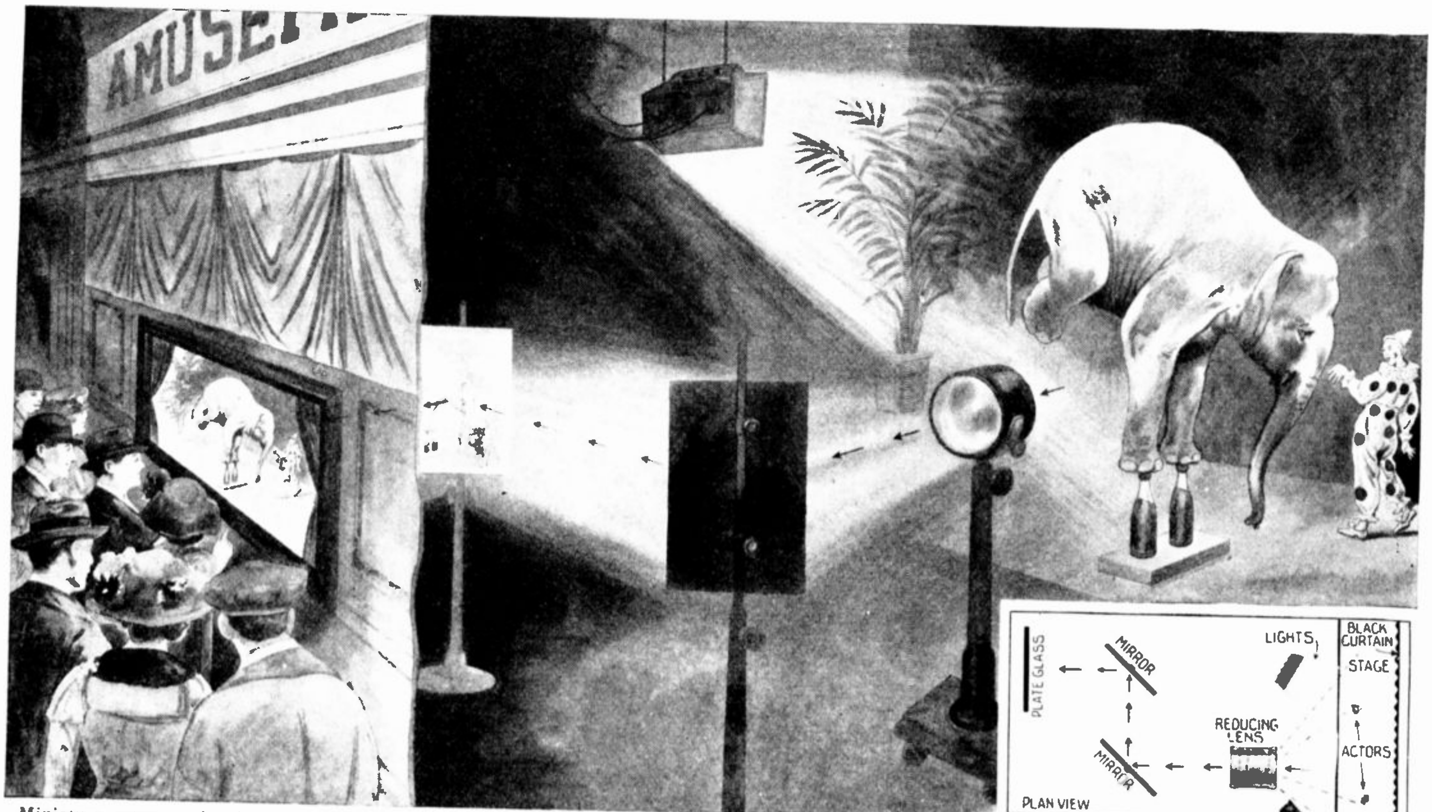
"The engine was belching great volumes of steam," writes an up-to-date novelist, who should know better, but we can hardly blame him because, whenever white clouds leave the exhaust pipe of a steam engine, we have been told for years that this is steam, when in reality it is only minute vesicles of water. Steam is invisible. No one has ever seen it. If you do not believe this, heat water in a retort and boil it. You will find that the steam can not be seen, but you DO see the condensation of the water as a white cloud which, however, is not steam at all.

Meteorites,—the stones that fall from the heavens, are not well understood in all their phases, and there is a glaring misconception on one particular point. Nearly every time that you read that a meteorite came flaming down from the sky, to bury itself in the earth, you read the astonishing statement that persons who touched the meteorite immediately upon its descent found that it was red hot. Other newspaper reports make the extraordinary statement that big stones took days to cool off. None of these statements is true. According to Dr. Arthur Tader Jones, Associate Professor of Physics of Smith College, the meteorite, when striking the earth, has about the temperature of ice water. He also says that "The temperature of a black sphere which is exposed to radiation from one direction, shows the theory that the meteor is near absolute zero is all wrong. One of the reasons is that the meteor, before reaching the earth, is exposed for a long time to the rays of the sun, which gives it a certain amount of heat."

The common cold is probably the most maligned of all human ailments. There are also many misconceptions as to its cause. Recent investigations have shown that there is a surprisingly small amount of colds during the summer. In the summertime the air is usually moist, thereby keeping the mucous membranes inside the nose and throat in a continuously moist state. In this state, the germs that enter either the nose or larynx do not have much chance to come into actual contact with the underlying tissue. The moisture continually washes these germs away, so they do not do much harm. In the wintertime, however, we shut ourselves up in hot rooms, where the air is comparatively dry. This dries up the mucous membranes and then, if we step out into the open air, the germs come into direct contact with the underlying tissues, where they begin their nefarious work. The usual cold is the result.

It is not that you "catch cold," but rather that your mucous membrane is dried up, which is the first step toward taking cold. The obvious remedy is to keep the rooms either well ventilated or, in the wintertime, when even the outside air is drier than in the summer time, we should have the rooms supplied with moist air. This can be readily done by placing upon stoves or radiators vessels containing water, so it can evaporate. The more water that evaporates, the better. The writer would even suggest vaporizing water in the living rooms every few hours, in order to take the abnormal dryness from the air.

H. GERNSBACK.



Miniature actors and animals go through their respective performances on a miniature stage to the astonishment of the audience, who cannot believe that beings could be so small and still live, but the method of arranging the reducing lens and the mirrors as shown in the view above explains the effect. The plan view inserted in the lower right hand corner makes the arrangement of the apparatus still clearer.

Trick Stage Makes Dwarfs

DURING the summer months of 1922 there was exhibited at Coney Island, New York, a most remarkable performance in the apparent reduction in size of human beings. When we say reduction of human beings we refer to the apparent reduction in the size of humans, without their undergoing any physical discomfort whatever. For that was actually what took place on a stage before the very eyes of the audience.

In a spacious lobby of the Tanagra Theatre, a "barker" called the attention of pleasure-seeking people to an exhibition, or rather performance, to be given on a stage 12 inches high and 24 inches wide, with as many normal-sized human beings on it as it could comfortably accommodate. Such a remark as this would naturally bring forth various comments from most any one; among them we heard "fake," and what not. Others said that the audience was hypnotized into believing that such a thing took place, etc.

The writer, like others, wanted to be "shown," and he as well as a number of others paid the entrance fee of ten cents. In due time, we witnessed a really interesting and entertaining performance of high-class vaudeville on this miniature stage. It was startling to see real human beings on such a small stage. These performers were going through their regular entertaining act.

After the performance, the manager of the theatre requested those of the audience who cared to be "reduced" to come in back of the stage so that their friends might see them in the guise of dwarfs. The writer was one of those that volunteered with over a dozen others. We, of course, experienced no ill effects, nor were any magic passes made before our eyes, nor were we told anything by the manager. The curtain was hoisted and there our friends beheld us reduced to a stature of about 8 inches. Immediately there arose a great applause and calls to wave the hands or other members of our anatomy, which we obligingly did.

The writer having at one time studied physics, made it his business to find what the real "trick" was that caused this reduction. In the course of a few minutes a lens and a pair of plain glass mirrors were noted. A second performance showed the entire *modus operandi*, and it is for the first time since this interesting device was imported from Germany that it is disclosed for our readers' benefit.

As the diagram shows, the subject is placed before a dark background; he is then focused upon a plain glass mirror by means of a large lens, and the angle of reflection corrected by a second mirror. From this second mirror the image is reflected upon an ordinary glass plate fitted into a picture frame, and appearing as a miniature stage, with the conventional drop curtain on which was painted ASBESTOS. The subjects wore colored clothes of high contrast, in order that the effect might be more striking. The lens was a fixed focus one.

Recently this clever optical system was employed at an exhibition of manikins at a ladies' fashionable clothing establishment, and motion pictures were even made of the characters on this unique reduction stage.

The Poly-Lingual Typewriter

By ROLAND D. JOHNSON

FEW people realize what a versatile machine the ordinary American typewriter with a standard keyboard can become under stress of necessity.

Anyone who handles a "typer" knows that with the standard keys he can write standard English of any kind, for the dieresis ("), the only diacritical mark used in standard English may be made by striking the "quotes" above a letter, for such words as "coöperate" unless it is preferred to write it "co-operate."

The same quotation marks that make a dieresis also make the *Umlaut* used in German, Norwegian and Swedish. Examples öre, früh, schönes.

Danish replaces the umlaut o (ö) by a special character which is made by striking the fraction line over the "o," thus "ø" "ø" Examples, øre, København.

That exhausts the possibilities of the standard keyboard, except that possibly Dutch may be written with it. However, most of the standard makers sell a model of machine which has the three accents used in writing French and either the French *c cedilla* (ç) or the Spanish *eñe* (ñ). Some other makers will replace certain of the little used "business characters" with the accents, or *c cedilla* or *eñe*. It happens that for the Oliver one may not have both *c cedilla* and *eñe*, for they both are made on the "N" block only. I find that the dash can be struck over a letter while the line space is moved down, and a satisfactory *tilde* or wave

(*Continued on page* 999)

How Much Gold Has Been Mined

By CHARLES NEVERS HOLMES

At this present time, gold is the most popular metal. Of course, it is not so rare as platinum or so common as silver, but, nevertheless, most nations base the integrity of their principal and interest upon gold. However, it has not always been the most popular metal. Indeed, the British monetary unit, the *pound sterling*, was originally a pound's weight of silver.

It is probable that gold was known in prehistoric times. It was certainly known during early Hebraic history. The Second Chapter of Genesis reports: "The whole land of Havilah, where there is gold." Also, "And Abram was very rich in gold." Accordingly, this precious metal must have been used for purposes of barter in the days of Abram. And since there was not much gold *in circulation* then, its scarcity caused it, in all probability, to be highly valued.

Despite the efforts of alchemists, past and present, gold still remains an element. We all know that it is a heavy metal, being about 19 3/10ths times as heavy as water. Gold melts at about 1,100 degrees, C. (2,012 degrees F.). It is soft metal, and is generally alloyed with copper to harden it for coinage and jewelry. It is not acted upon by moisture or oxygen, although soluble in a mixture of hydrochloric and nitric acids. Gold is, also, very ductile and malleable, and can be beaten out into exceedingly thin leaves, about 1/250,000th of an inch in thickness.

Gold occurs almost wholly in the free state, being often found in quartz or sand. Owing to its weight, it is sometimes easily mined, inasmuch as the other mineral matter around it may be washed away by water, the heavier gold remaining behind. Also, its ore may be crushed in stamp mills, and then, this crushed ore is passed over copper plates coated with mercury. The gold and the mercury form an amalgam, and, afterwards, the gold is recovered by distillation. Moreover, there is the *cyanide process*, wherein the precious metal forms a compound with sodium cyanide. The gold is then separated from this compound by electrolysis.

Gold is very widely distributed, but, except in lodes and deposits, its glittering particles are not plentiful enough to defray the expense of mining it. There is a trace of it in the water of the ocean, but it is chiefly found on land. From the year 1493 to 1520, men mined about 5,200,000 ounces of fine gold, whereas during one year, in 1861, they mined about 6,000,000 ounces. In 1870, more than 6,000,000 ounces were produced; in 1880, only about 5,000,000; in 1890, about 5,750,000; in 1900, more than 12,000,000; during 1910, about 22,000,000; and in 1920, almost 17,700,000 fine ounces. Since 1860, the smallest world production was in 1874—about 4,400,000 ounces—and the greatest production in 1915—more than 22,674,000 ounces. Of course, man won a great deal of gold out of the earth, just after its discovery in California. From the year 1851 to 1855, he mined 32,000,000 ounces of fine gold.

At this present time, Africa produces by far the most gold, North America being

(*Continued on page* 1031)

The production of the gold in the United States in comparison with the gold produced by the rest of the world, is graphically depicted in the drawing above. The amount of gold produced in the United States if rolled into a solid rod three inches in diameter would be longer than three of the largest steamships afloat. If made into the form of a coin, it would stand but two feet lower than the Singer Building. The world's production of gold would tower above the famous Eiffel Tower structure, and if rolled into a rod ten feet in diameter it would be higher than the Woolworth Building. A road ten feet wide and one foot thick could be paved with the world's gold for a distance of almost one and a third mile

World's Largest Photo on Mountain

By CARL TAYLOR

THE production of a huge picture printed on a face of natural rock in exactly the same manner a photographer prints ordinary negatives in his darkroom! is the remarkable scientific feat Gutzon Borglum, world renowned sculptor has set for himself to aid in carving the Confederate Memorial on the unscalable side of Stone Mountain, sixteen miles east of Atlanta—the first time in the annals of photographic science that such an attempt has been made.

Using the night for his darkroom, he will project his negative through a range of 700 feet for four hours exposure.

He will use the most powerful projecting lamp ever constructed, while barrels of sensitizing chemicals, developer, fixing baths and plain water will be poured down the mountainside in proper sequence so that the picture will attain the right effect.

Mr. Borglum plans to make the attempt some dark night early in February or March, just as soon, he says, as the projecting lamp can be constructed and delivered to him and placed on its concrete base 700 feet from the mountain.

After the lamp has been stationed at exactly the right position, workmen on the top of the mountain will be signalled by telephone to pour the sensitizing solution. Between fifty and seventy-five barrels of high grade chemicals will be applied to the surface of the rock.

Then the transparency of the drawing of the principal figures in the memorial will be placed in the projecting lantern and the light will be turned on. For four hours it will shine against the sensitized rock, so that the negative will be sure to receive a sufficient exposure.

Then the workmen will be told to pour on the developer, followed by the fixing bath and finally clear water to remove all chemicals from the print, allowing it to stand out boldly and plainly discernible with the naked eye from the base of the mountain.

Since he conceived the idea of carving the Confederate Memorial on the sheer side of the mountain, one of Mr. Borglum's biggest problems has been how to outline the figures before the work of carving them began.

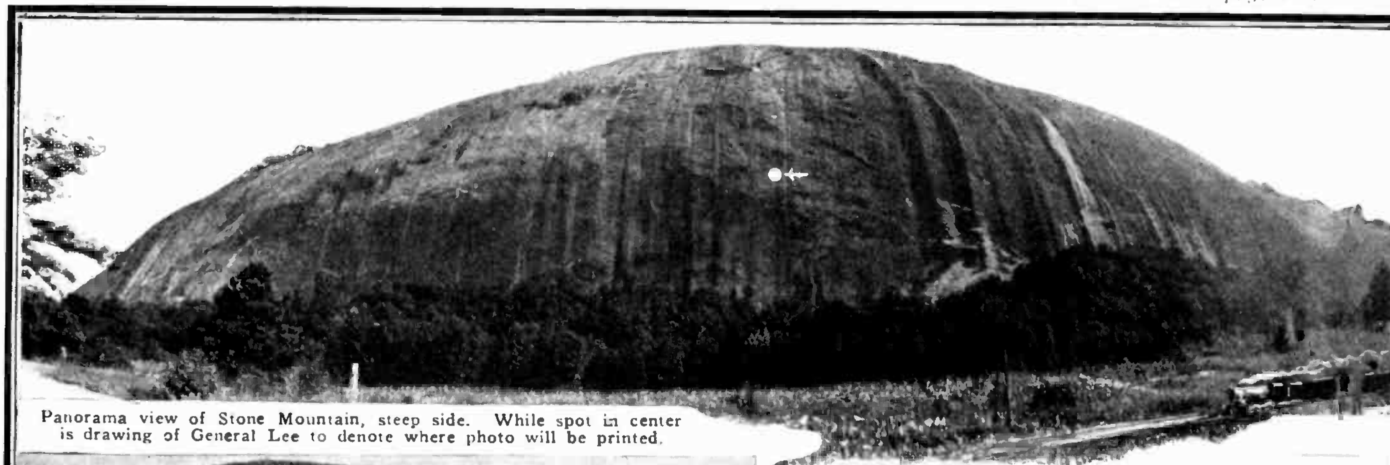
The reason can be made clear at once by showing the situation that confronts him.

He is going to carve the memorial on the side where the rock goes straight up and down for 900 feet, a smooth, unscalable wall of granite. He has selected a point 300 feet from the ground for the principal group, which will include General Robert E. Lee, General John B. Gordon, President Jefferson Davis and others all mounted on horseback, drawn up to review their troops.

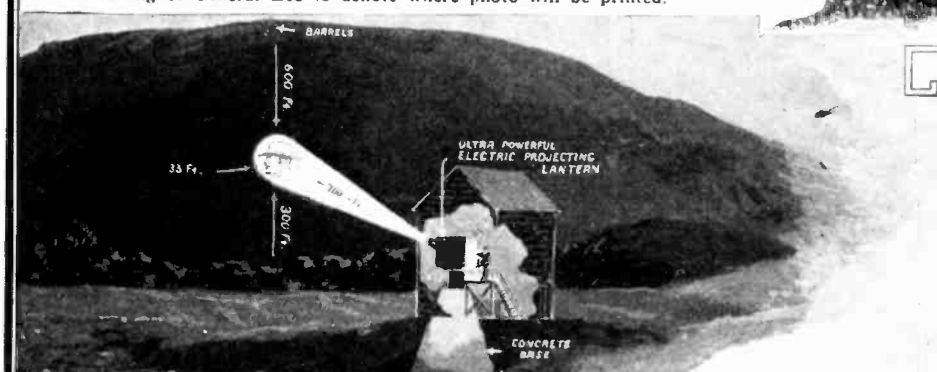
Before the carving begins, the figures must be outlined on the mountain in some manner.

The plan of sketching the pictures on canvas and placing them where they were to be carved was tried, but did not work out

(Continued on page 1033)



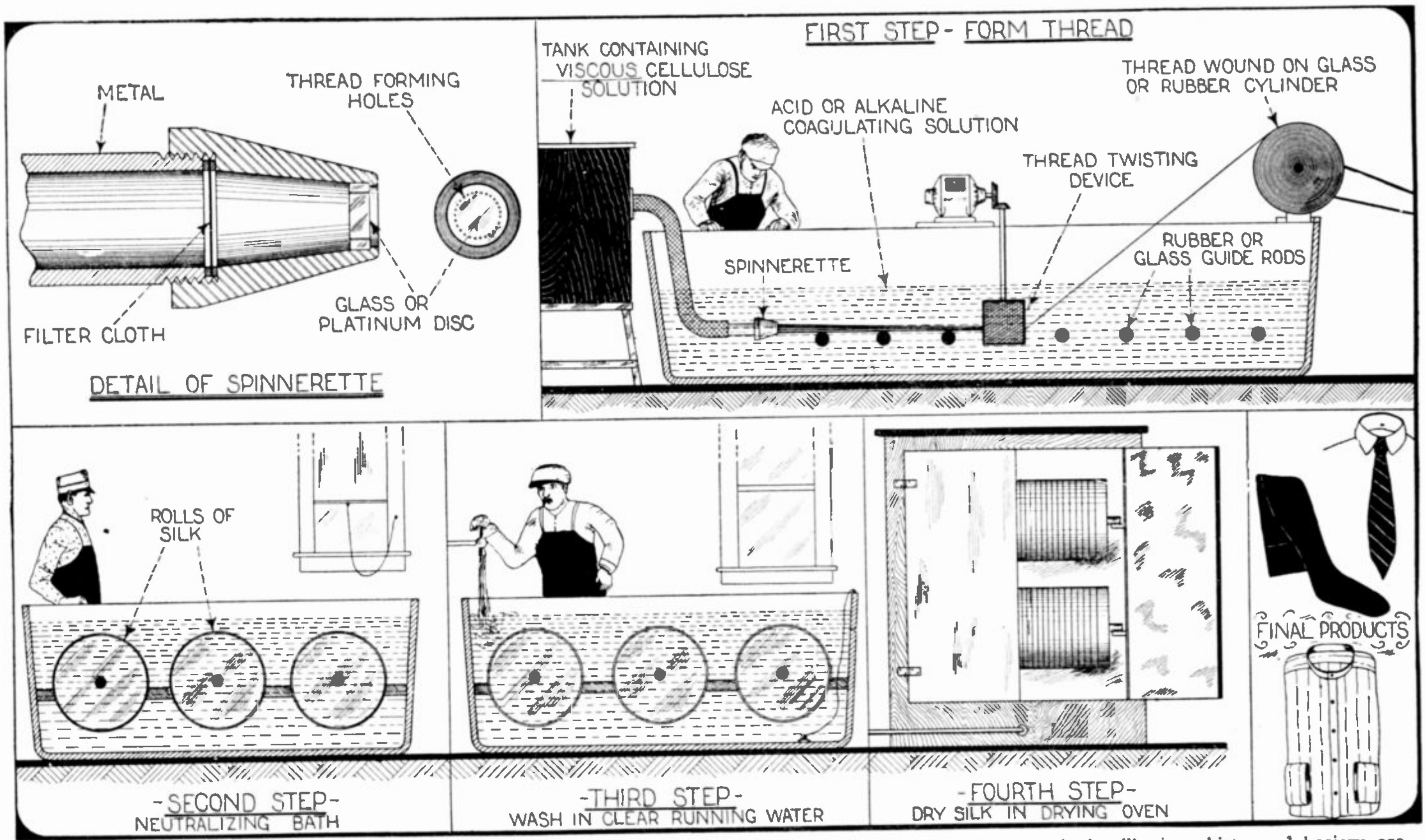
Panorama view of Stone Mountain, steep side. While spot in center is drawing of General Lee to denote where photo will be printed.



Lower Left—Drawing of principal group in Stone Mountain Memorial, as it will look when Borglum photographs it on the mountain.

At Right—Mr. Borglum at work.

Left Center—How Mr. Borglum will print his picture on the side of Stone Mountain.



Artificial or "synthetic" silk is used more extensively today than most of us could ever imagine. While synthetic silk ties, shirts, and hosiery are well known, the exact method of making this man-made competitor of the silk-worm, is not so well understood, for the very good reason that the manufacturers of this product have wisely and jealously guarded their secrets. The successive stages followed in one of the principal processes for making artificial silk are shown progressively above, and described in detail in the accompanying story by Mr. Samuel Wein, Chemist.

Artificial Silk--How Made

By SAMUEL WEIN

WHEN the production of an industry is doubled in a single year, that industry bears watching. This happened during 1921, and it happened in the case of artificial silk manufacture in the United States—and certainly this particular industry is getting all the watching it deserves. The widespread interest taken in its progress during 1920 has not abated during the last year, but it has increased to a marked extent.

The total production of artificial silk in this country in 1921 was in the neighborhood of 20,000,000 pounds. Figures do not always mean much but possibly this one will become more graphic if it is recalled that a reliable estimate made in 1914 placed the entire annual production of artificial silk in the world at only 26,000,000 pounds.

As the great bulk of the American output went into domestic consumption, it can be realized that the use of artificial silk has broadened to a remarkable degree.

ITS CHIEF USES

Artificial silk is used very extensively by the feminine sex for divers uses, especially for wearing apparel. One of the largest manufacturers recently tabulated some of its uses and its monthly consumption thereof. These are:

	Pounds
Shoe laces	5,000
Garters	5,000
Elastics	5,000
Sweaters	50,000
Neckties	20,000
Braidings and trimmings	15,000
Mufflers	10,000
Tricoteens	10,000
Hosiery (50,000,000 pairs)	200,000
Shirtings, etc.	59,000
Broad silks	50,000
Fancy weaves	25,000
Plushes	5,000
Carpets	5,000
Fabrics, tassels, etc.	5,000

There are less than a handfull of firms in the United States supplying this large demand for artificial silk. This is because of the fact that it takes an enormous amount of ready money to finance a plant to manufacture several hundred pounds per week.

ORIGIN OF ARTIFICIAL SILK

The idea of producing artificial silk is not by any means a modern one. Réaumur, the French physicist and naturalist, indicated the possibility of its manufacture in 1754. In his memoirs relating to the history of insects he states explicitly: "Silk is only a liquid gum which has been dried; could we not make silk ourselves with gums and resins? This idea, which would appear at first sight fanciful, is more promising when examined closely. It has already been proved that it is possible to make varnishes which possess the essential qualities of silk. Chinese lacquers and similar varnishes are unaffected by solvents; water has no affect on them; the greatest degrees of heat to which our fabrics are exposed could not change them. If we had threads of varnish we could make them into fabrics which, by their brilliancy and strength, would imitate those of silk, and which would equal them in value, for good varnishes when properly dried have no smell. But how can we draw out these varnishes into threads? We cannot, perhaps, hope to draw out these threads as fine as those obtained from silkworms, but this degree of fineness is unnecessary, and it does not seem impossible to make them into threads, perhaps, as fine as natural silk, when we consider to what extent art may be carried."

From the foregoing, it would naturally seem that the French physicist had the right idea as to how artificial silk may be made; in fact, by modern methods and chemical procedure we do make threads as fine as that made by the silkworm.

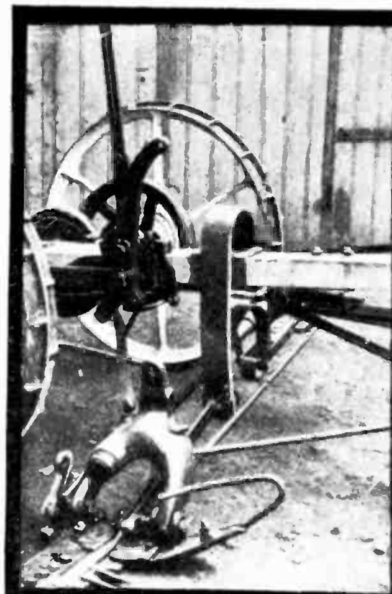
THE CHEMICAL PROCEDURE

In the manufacture of artificial silk today resort is had to dissolving cellulose (wood-pulp, cotton, ramie, rhea, grass, jute, hemp, straw, etc.) in a proper solvent, until a proper solution is had free from particles or undissolved chemicals. This solution is more or less viscous, and it is forced by means of air pressure through a very fine hole or orifice; the viscous solution emanating from the orifice corresponds in its thickness to that of the diameter of the hole itself (the thickness of the thread). The viscous solution is forced into a liquid (depending on the process used) which immediately coagulates or rather congeals the solution into a solid thread. This thread is twisted with a number of other threads in the form of strand, washed in water and chemicals to dispose of the impurities it may contain (such for instance as the solvent for the cellulose itself, or other chemicals that may result therefrom). The strand of thread is now wound on a glass or rubber tube or frame and the thread is dried under tension. When the thread is perfectly dried it will be found to have all the characteristics of real silk.

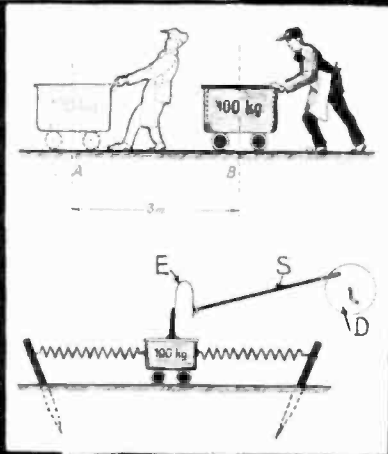
THE COLLODION PROCESS

One of the very first processes discovered for the manufacture of artificial silk employed ordinary collodion (a solution of nitrated cotton, or nitro-cellulose). This was forced through a fine hole or orifice (called the spinnerette) and into a coagulating solution of cold water. This process at first attracted much attention when it was introduced, but was discarded because the material into which it was afterwards spun was very inflammable, in fact many serious accidents resulted from fires due to its use. The process was more or less expensive, on account of the alcohol and ether used as the solvent for the nitro-cellulose.

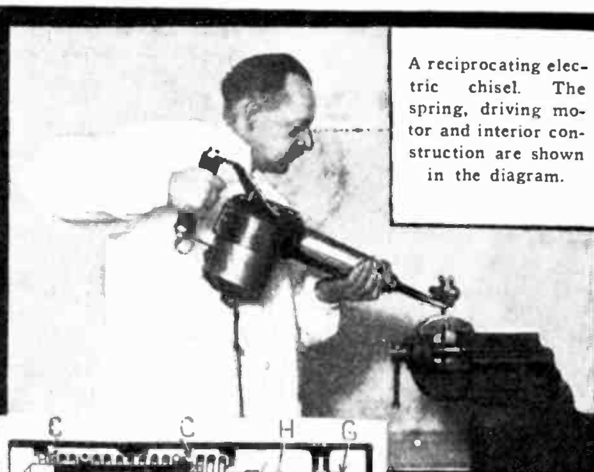
(Continued on page 1001)



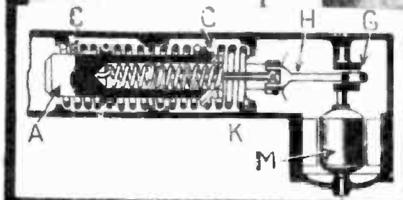
Left:—A reaping machine in which the spring system is applied to the reciprocating motion of the knives in the finger bar.



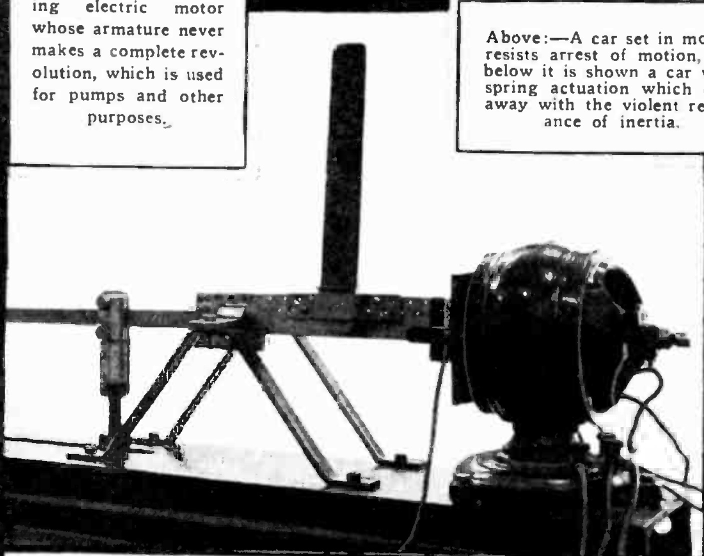
Above:—A car set in motion resists arrest of motion, but below it is shown a car with spring actuation which does away with the violent resistance of inertia.

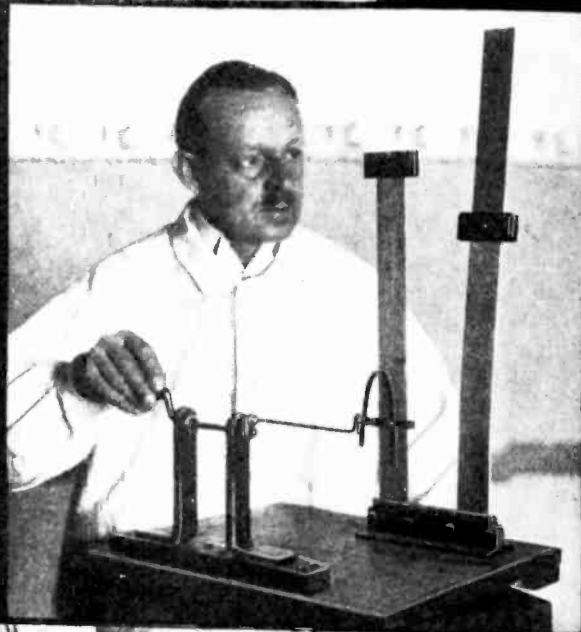


A reciprocating electric chisel. The spring, driving motor and interior construction are shown in the diagram.

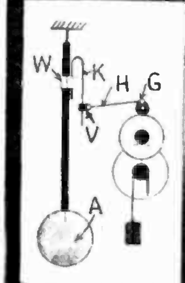


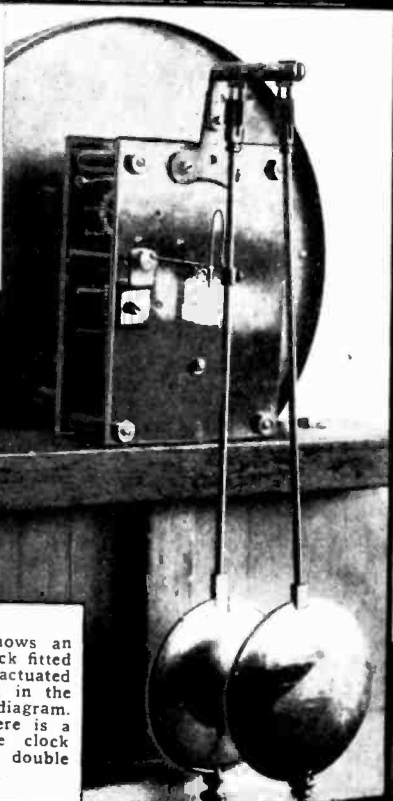
Below:—An oscillating electric motor whose armature never makes a complete revolution, which is used for pumps and other purposes.

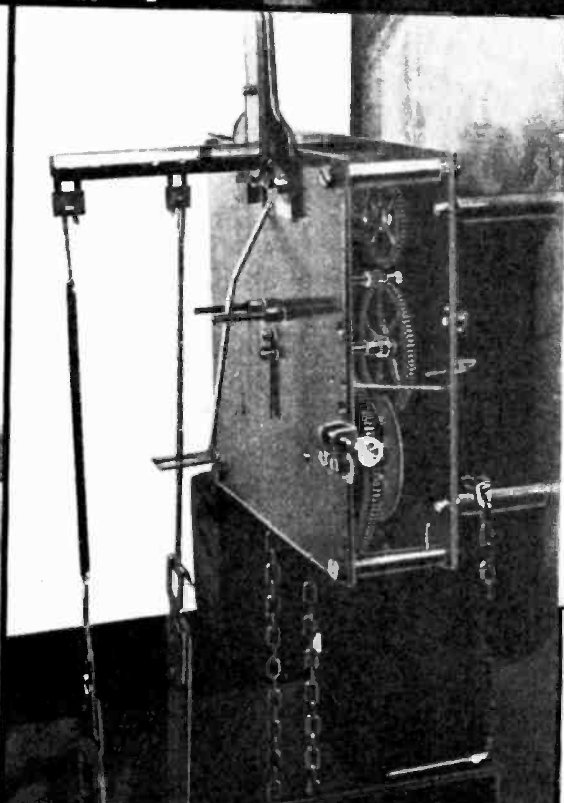




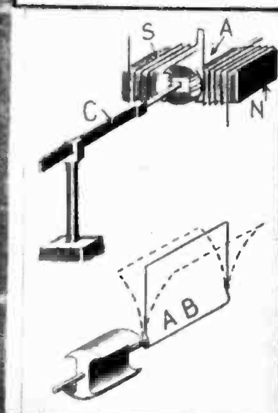
Above is shown an experiment carried out with two steel bars with spring coupling, the bar at right oscillating violently at the proper periodicity.







Above:—This shows an old fashioned clock fitted with the spring actuated pendulum, shown in the upper corner diagram. On the right there is a very high grade clock with the same double pendulum.



Above:—A diagram of the oscillating motor, whose armature never makes a complete revolution.

Oscillatory Power

By Dr. ALFRED GRADENWITZ

Applying the Results of Radio-Telegraphy to the Improvement of Mechanical Engineering

AN epoch-making invention, or rather, discovery, was, for the first time, brought to the attention of the public when at the end of October, Chief Engineer H. Schieferstein, in the lecture hall of the Huth Radio Company, of Berlin, treated a circle of invited guests to a demonstration of his scheme of applying the tuning principle familiar to radio workers to an unexpected improvement in mechanical engineering:

Each time the direction of motion of a given body or system of bodies is reversed, the resistance opposed by its inertia has, of course, to be overcome anew, thus making the loss of energy the greater, as the change of direction is more frequent. In the case of a very rapid shifting of direction, the loss of energy thus incurred may amount to many times the useful effect and may eventually destroy the whole mechanism. Countless units of motive energy are thus being wasted to no account, depriving the economic life of mankind of enormous values.

This state of affairs was considered irremediable until Mr. Schieferstein, a well-known worker in the field of wireless, succeeded in finding a way out of the difficulty. It occurred to him that losses such as these, in the case of reciprocating machines, could be avoided by converting them into oscillating systems, endowed with a marked oscillation of their own, the loss being even turned into a remarkable improvement of efficiency by tuning them to the driving medium. When tuning the elements of a machine or engine to the working number of oscillations, they are found not only to do their work willingly and readily, but even to yield a considerable surplus of power with the same expenditure of energy. The adoption of tuning in mechanical engineering and instrument making could properly be termed an improvement of manners in the mutual intercourse between machine elements.

The most remarkable point in this connection is that the mechanisms thus brought into play are by no means very efficient in themselves or of very difficult manufacture. Quite the contrary, the fundamental element of the whole arrangement is merely a mechanical system capable of oscillating, which is elastically coupled to a crank. In fact, the new principle is readily applied to all the various constructions in the immense field of reciprocating motion.

The following elementary test was made by the inventor to demonstrate this working principle: Two vertical iron rods are fastened beside one another on the same base-plate. One of them carries a counter weight fixed to it in an immovable position and, accordingly, has a characteristic number of oscillations, whereas an adjustable weight sliding along the other bar can be fastened at any height desired, thus altering within certain limits its period of oscillation. When this adjustable rod is tuned to the characteristic period of the other rod, the latter is found to communicate to it its own oscillations. The constant-period rod also comprises an elastic spring connected to a crank, which is turned by the experimenter: Whenever the number of turns of the crank is the same as the period of oscillation of the rod, the latter is caused to oscillate most violently, while the other rod only partakes of this oscillatory motion if tuned to the system.

The principle has been tested in actual practice on *percussive tools and harvesting machines*, the additional energy (as indicated on a brake-dynamometer) being, in accordance with the speed and mass of the oscillatory system, up to several times the useful output previously recorded. One harvesting machine, *e.g.*, during this year's haymaking, showed an average energy expenditure of 55 units, whereas, according to data by the German Agricultural Society, average figures with ordinary harvesters are intermediary between 105 and 155 units, even fluctuating up to 250 units.

In the case of other machinery, *e.g.*, *steam engines*, *Diesel engines* and other types of prime mover, the new principle affords an enormous advantage; any objectionable inertia effect, as the speed increases, is avoided, thus enabling engines of high speed of rotation to be constructed.

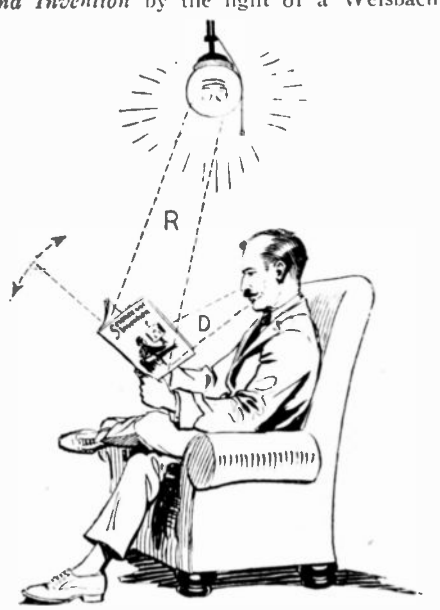
Another remarkable application of the new principle is embodied in the design of *noiseless timepieces* without escapements, the complicated and expensive anchor being replaced by continuous excitation by means of the revolving shaft. In fact, any clockwork of crude manufacture, by surprisingly simple means, may be turned into a high-precision chronometer. Of special interest is further the *oscillating electric-motor* which, being tuned to 50-cycle alternating current, performs 3,000 oscillations per minute and, in conjunction with an oscillating plate, serves as fan, vacuum cleaner or exhauster. This is the first synchronous motor able to start under full load and without any outside aid.

The new principle will, however, open up quite a new field, *e.g.*, that of mechanically oscillating driving mechanisms, suitable for the *propulsion of gliding boats, ships and airplanes*, the fundamental element in this connection being the tuned oscillating plate.

According to a theory advanced by the inventor and which could be checked by moving pictures, the squadron flight of a certain migratory birds is based on a mutual tuning, the stronger individuals communicating some of their energy to the weaker ones. A squadron of airplanes fitted with tuned vibratory systems could, in a similar way, be made to fly in unison.

Try This Experiment

If you are reading this copy of *Science and Invention* by the light of a Welsbach light, you can forcibly demonstrate a not to be neglected law of physics, that of the property of sound to be reflected by surfaces, with the magazine which you have in your hand.



Have you ever noticed that certain sounds are more audible when your magazine, placed in front of you is inclined at a suitable angle, so as to reflect those sounds? Try the experiment.

It is understood that you are in a correct reading position with reference to the light. Slowly turn *Science and Invention* with outspread pages, up and down, using a horizontal line half way down the page and running across it as an axis. You will at a definite position of the magazine, hear the rushing sound of the Welsbach light as the air is being sucked in at the holes at the mixing port of the burner. Naturally you can hear the sound of the light ordinarily, but the sound obtained by cautiously twisting *Science and Invention* is many times louder than the normal.

Using the fold running vertically up and down the spreaded pages as an axis, you can further amplify with one hand and a downward movement with the other.

Sound waves are deflected by objects. The drawing makes clear how the sound caused by the burner is deflected on the magazine and then transmitted to the ear.

The ear receives only a small part of the sound waves from the burner but when the large surface, afforded by *Science and Invention* is used, the sound is gathered together and thrown directly at the reader's head.

Novel Rolling Suitcase

The suitcase shown below should prove a boon to the foot-sore traveling salesmen who must cover long stretches of territory in more or less populated districts carrying heavy samples with him. Such a traveling suitcase would be found very effective for the demonstration of a new kind of typewriter, or other heavy article.

Rolling suitcase, fantastic invention of a Berlin engineer. As we usually carry a bottle in ours we do not think we will abandon the old one.

Navigating Interstellar Space

By CHARLES FREDERICK CARTER

THE announcement of Prof. T. J. J. See, Government Astronomer at Mare Island, that he had discovered the cause of universal gravitation was made just in time to lend an air of plausibility to a tale of adventure that fairly outdistances any previous flight of imagination. The story is produced as a moving picture, entitled "The Sky Splitter."

Originally conceived as an entertaining phantasmagoria, "The Sky Splitter," in the light of Professor See's discovery, becomes a suggestion of fascinating scientific possibilities—not probabilities, however. Since we now know what gravitation is, if we follow, understand and believe Professor See's conclusions, may we not apply that knowledge of the force which holds the planets in their orbits to navigation of interstellar space? Can we not now go and find out for ourselves whether Mars and Jupiter and Venus and other planets that have been discussed are really inhabited or not? All that is lacking now is suitable motive power. The source of that has been suggested by the discovery of radium by the Curies.

The scenario writer has certainly beaten science by a few laps (perhaps). Briefly, the story of "The Sky Splitter" is about Prof. Adam Cooley, B.A., Ph.D., D.Sc., like Professor See, an astronomer, who has devoted the better part of his life in attempting to develop a motor, actuated by atomic force which is now supposed to be akin to the emanations from radium. In time, the Professor masters the secret. He decides to try it out on an old automobile, so that if anything happens he will not lose much. That was a lucky thought, for atomic force when harnessed proves to be so much more powerful than anything hitherto known, that the Professor runs into a stone fence and comes pretty near being launched into infinity without any further aid from atomic force.

Naturally, he is laughed at after this experience. Many great discoverers have had the same experience. If Professor Cooley had been overlooked, that fact would have demonstrated that he was not the real thing in discoverers.

Unluckily for him, one of the scoffers is Paul, who adores Marcel, Professor Cooley's daughter, a maiden as beautiful as the houris and as wise as Zobeide. She gives Paul a piece of her mind for his rudeness to her father and in polite phrase tells him to go. The only way Paul can get back into Marcel's good graces is to play Angel to the Professor's discovery. In other words, Paul advances the money to build a Projectocar in which the Professor proposes to go on a voyage of discovery among the stars, the propelling power to be his newly patented atomic force motor.

March Features in Science and Invention

The Star—A Tale of the Comet. By H. G. Wells, World's Famous Scientific Fiction Writer, Who Holds Your Interest to the Last. Don't Miss It.

Chicago-New York-Berlin-Via Zeppelin. By Dr. Becher. Illustrated with latest photos of German airships.

Radio Wave Traps and Filter Circuits for Maximum Selectivity. By A. P. Peck.

Practical Chemical Experiments—A brand new series. By Raymond B. Wailes. Illustrated.

The Obedient Candles—Magic For the Amateur. By Joseph H. Kraus.

How and When Does Electricity Kill—Popular discussion, with illustrations for the layman.

How to Use Your Camera—Part 3. By Dr. Ernest Bade.

Telegraphing Pictures Across the United States. By D. W. Isakson.

Measuring One-Millionth of an Inch.

How Old Is the World? By Harry Van Demar.

Why Balsa Wood Weighs Less Than Other Woods. By Dr. Becher.

On the same theory that he used an old auto for his first experiment with the new motive power, Professor Cooley refuses to risk wasting any more of the family than necessary on his voyage into infinity. Marcel is ordered to stay at home, while the Profesor sails off alone.

The Projectocar is launched down a steel toboggan slide from the top of a steel structure like the Eiffel Tower to give it sufficient momentum to carry it off into space, for it has no landing wheels. Professor Cooley enjoys the first few seconds of his voyage as he gazes back at the swiftly receding earth. But when he finds himself beyond the earth's atmosphere he begins to wonder whether, after all, his voyage was wise. He reaches for his control levers, but finds them useless because there is no resisting atmosphere to be worked upon. By this time he is quite sure he made a mistake in leaving the best world he ever lived on. He faints away.

On recovering he plucks up courage again; he looks out of his periscope to find that his Projectocar is racing with a comet and leaving it behind as if it was tied to a post. Next he flashes past a planet which he recognizes as Saturn, on account of its fondness for rings. Soon he finds himself approaching a planet to which he has never been introduced, astronomer that he is. Thinking the joke has gone about far enough he once more plucks at his lever in a frenzy of energy, determined to make a landing. To his joy, he finds the controls working perfectly, for he is in an atmosphere once more. He circles gracefully about seeking a landing but not being too particular about it. All he wants now is to get out of that Projectocar.

Upon coming to rest, he alights and is greeted by beings, who, he sees at once, are of superior intelligence. At least they have sense enough to stay at home and not go gallivanting around among strange stars. There is some difficulty in making himself understood, but upon being conducted to an observatory he finds astronomical maps on which he locates the earth. He indicates that he came from there. The strangers are too polite to apply the short and ugly word. Instead, they focus their telescope on the earth and invite Professor Cooley to look.

The telescope is so much more powerful than any known on this earth that the Professor is actually able to pick out his old home town. But it doesn't look familiar. Finally, though, it dawns upon him that he has traveled so much faster than light, the swiftest thing hitherto known, that he is now actually seeing images that left the earth on beams of light when he was a boy fifty years before. Calling for pencil and scratch pad, Professor Cooley does some rapid calculating and finds that he is now 293,994,584,070,194½ miles from home. If he is to get back in time for the wedding of Paul and Marcel, he will have to hurry even with so swift a vehicle as the Projectocar.

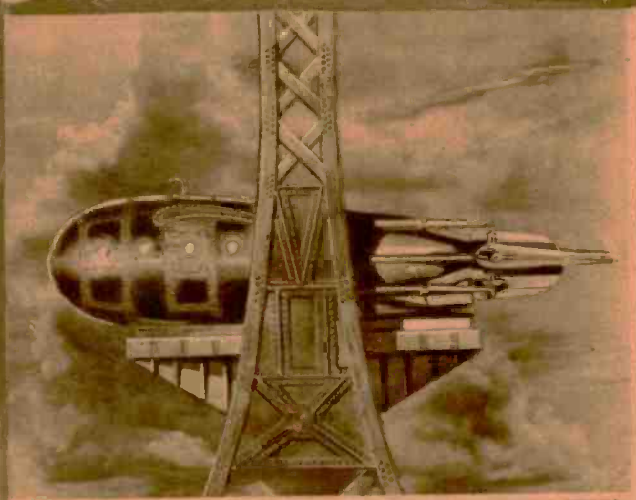
Before dismissing this with a laugh, try to remember what you thought of Jules Verne's "Twenty Thousand Leagues Under the Sea." That was too fantastic to discuss when it was first published. Navigating the depths of the sea was wildly impossible. But since then the submarine has become commonplace. If the force that holds the planets in their orbits can be utilized to provide a suitable medium for navigation, and we can devise a motor sufficiently powerful—and scientists have been working for years to master the mystery of radium emanations, the most powerful thing yet discovered—may not such a trip become possible?—*Photos courtesy of the Bray Productions.*

Transparent Paper

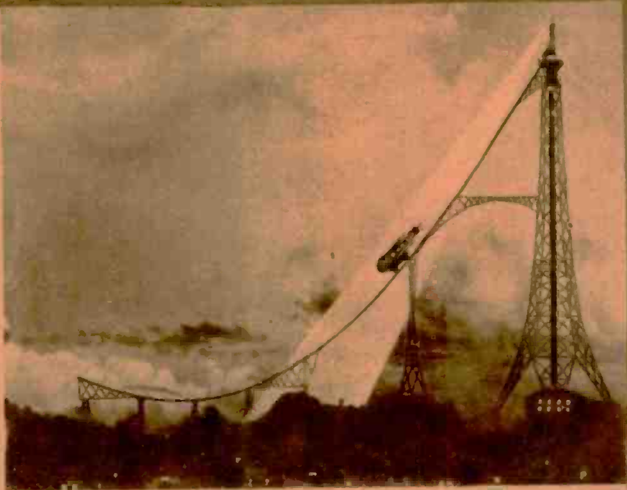
FOR over fifty years chemists and paper manufacturers have been actively engaged in the production of transparent paper. Some of the processes used by these investigators involved impregnating the paper with all sorts of substances, such for instance, as fats, oil, resins, gums, and other similar compounds. Several years ago a paper, entitled Glassine, appeared on the market. This paper, as well as those paper resulting from the treatment with the products mentioned, was not transparent, but rather translucent. Furthermore, the use of such papers is more or less limited, inasmuch as they have a tendency to impart an odor or greasiness to the object with which it is wrapped.

Recently, a Milwaukee manufacturer has brought on the market a perfectly transparent paper, without taste, odor or greasiness. In fact, this paper has some remarkable characteristics that make it superior to celluloid in some respects. The new product is sold in various grades of hardness, thickness and other physical grades, as it may find application in the market. The paper is known as "Cellulin." Some of the grades are as thin as ordinary tissue paper (.001/2) and intended for wrapping purposes, such for instance, as candy, fancy boxes, food stuffs, window-envelopes, sausage casings, etc. Whereas, the thicker grades are used for the same purposes as celluloid, in fact find ready application for the manufacture of the ordinary motion-picture films, automobile curtains, etc. Cellulin is preferred to celluloid because of the fact that it is cheaper; furthermore, it is not so readily combustible as is celluloid. Cellulin is not soluble in water, nor is it affected by the organic solvents that celluloid or similar products are soluble in. The heavier grades (.005) are absolutely non-inflammable, and the peculiar yellowish cast is absent in Cellulin.

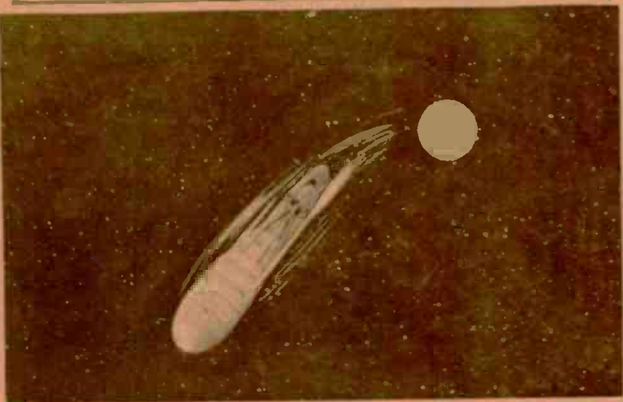
The STELLAR EXPRESS



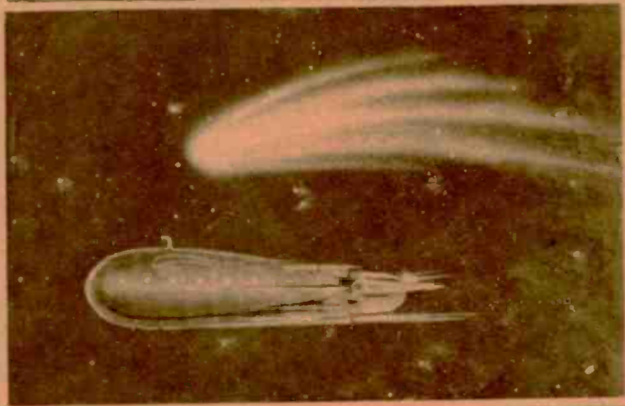
Professor Cooley's projectorcar for navigating interstellar space on its elevated launching platform.



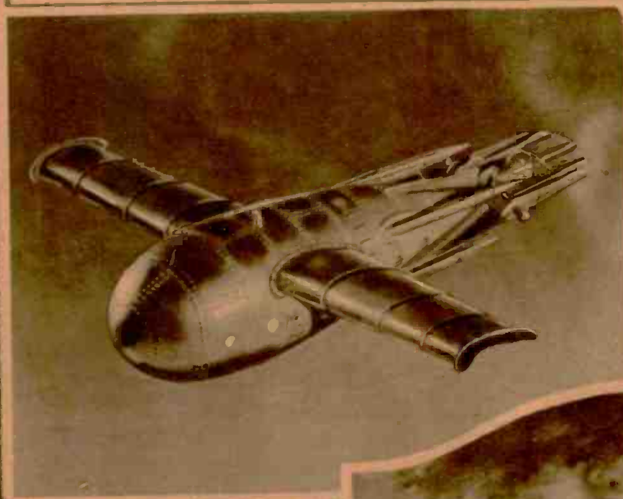
The projectorcar being launched from high tower, for its first trip to Mars and other planets.

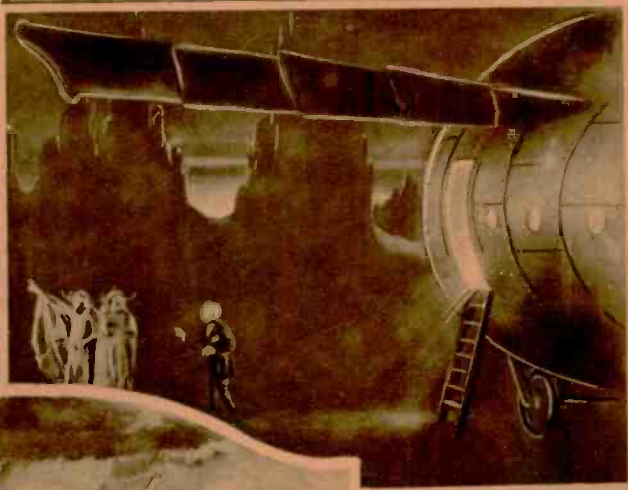


Professor Cooley's projectorcar leaving the earth behind on its journey to other planets.



The stellar express has a race with a comet, and out-speeds the fiery demon of space.





Professor Cooley's stellar express spreading its telescopic wings, preparatory to alighting on an unknown planet. The machine is designed so that when once in flight, the wings may be telescoped, so as to minimize air friction and realize the maximum speed.

The picture to the right shows the giant observatory on the strange world, from which Professor Cooley, looking back at the earth, discovered that he had actually beaten light itself by fifty years.

Picture above shows Professor Cooley alighting on strange world from his space flier, after the most extraordinary voyage in all history. He gets a cordial reception from the strange dwellers in the unknown world.

The New Accelerator

By H. G. WELLS

CERTAINLY, if ever a man found a guinea when he was looking for a pin it is my good friend Professor Gibberne. I have heard before of investigators overshooting the mark, but never quite to the extent that he has done. He has really, this time at any rate, without any touch of exaggeration in the phrase, found something to revolutionize human life. And that when he was simply seeking an all-round nervous stimulant to bring languid people up to the stresses of these pushful days. I have tasted the stuff now several times, and I cannot do better than describe the effect the thing had on me. That there are astonishing experiences in store for all in search of new sensations will become apparent enough.

Professor Gibberne, as many people know, is my neighbor in Folkestone. Unless my memory plays me a trick, his portrait at various ages has already appeared in various magazines, but I am unable to look it up, because I have lent my volume to someone who has never sent it back. The reader may, perhaps, recall the high forehead and the singularly long black eyebrows that give such a Mephistophelian touch to his face. He occupies one of those pleasant little detached houses in the mixed style that make the western end of the Upper Sandgate Road so interesting. His is the one with the Flemish gables and portico, and it is in the little room with the mullioned bay window that he works when he is down here, and in which of an evening we have so often smoked and talked together. He is a mighty jester, but, besides, he likes to talk to me about his work; he is one of those men who find a help and stimulus in talking, and so I have been able to follow the conception of the New Accelerator right up from a very early stage. Of course, the greater portion of his experimental work is not done in Folkestone, but in Gower Street, in the fine new laboratory next to the hospital that he has been the first to use.

As everyone knows, or at least as all intelligent people know, the special field in which Gibberne has gained so great and deserved a reputation among physiologists includes the action of drugs upon the nervous system. On the subjects of soporifics, sedatives, and anaesthetics he is, I am told, unequalled. He is also a chemist of considerable eminence, and I suppose in the subtle and complex jungle of riddles that shadows the ganglion cell and the axis fibre there are little cleared places of his making, little glades of illumination, which, until he sees fit to publish his results, are still inaccessible to every other living man. And in the last few years he has been particularly assiduous upon the question of nervous stimulants, and already, before the discovery of the New Accelerator, had attained great success with them. Medical science has to thank him for at least three distinct and absolutely safe invigorators of unrivalled value to practising men. In cases of exhaustion the preparation known as Gibberne's B Syrup has, I suppose, saved more lives already than any lifeboat on the coast.

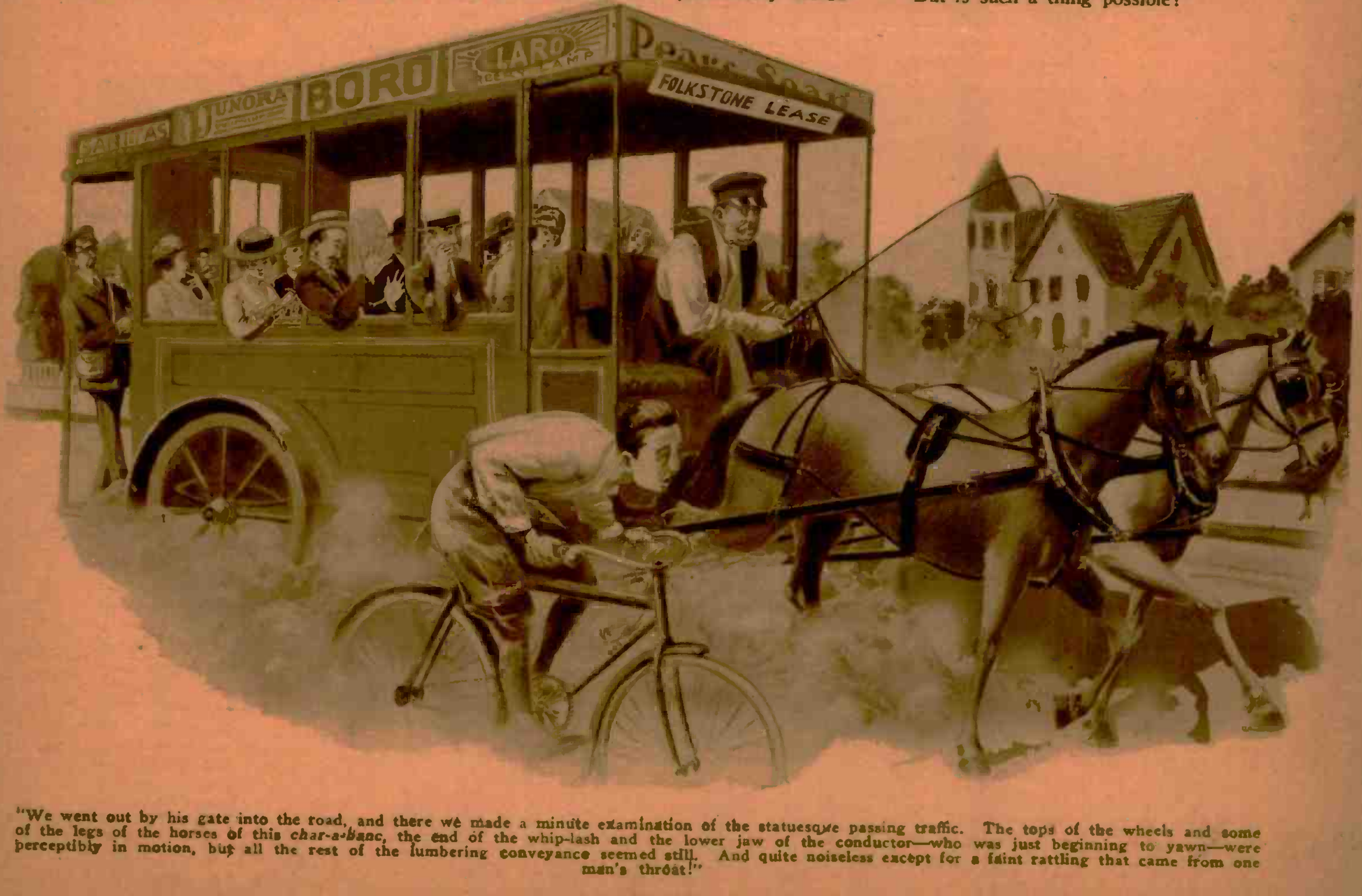
H. G. Wells, the famous English writer of scientific fiction stories and books, needs no introduction to our readers. We are fortunate indeed in having secured several scientific stories by this brilliant writer, who never fails to hold the interest of his readers. Mr. Wells will be remembered by his unusual and original "The War of the Worlds"; "The Time Machine"; "The Outline of History" and "A Short History of the World," not to mention numerous other interesting and original articles from his pen. The editor well remembers the first time he ever read a work by Mr. Wells—"The War of the Worlds"—and he has eagerly watched ever since for further dissertations from this master writer.

"But none of these little things begin to satisfy me yet," he told me nearly a year ago. "Either they increase the central energy without affecting the nerves or they simply increase the available energy by lowering the nervous conductivity; and all of them are unequal and local in their operation. One wakes up the heart and viscera and leaves the brain stupefied, one gets at the brain, champagne fashion, and does nothing good for the solar plexus, and what I want, and what, if it's an earthly possibility, I mean to have—is a stimulant that stimulates all round, that wakes you up for a time from the crown of your head to the tip of your great toe, and makes you go two—or even three to everybody else's one. Eh? That's the thing I'm after."

"It would tire a man," I said.

"Not a doubt of it. And you'd eat double or treble—and all that. But just think what the thing would mean. Imagine yourself with a little phial like this"—he held up a little bottle of green glass and marked his points with it—"and that in this precious phial is the power to think twice as fast, move twice as quickly, do twice as much work in a given time as you could otherwise do."

"But is such a thing possible?"



"We went out by his gate into the road, and there we made a minute examination of the statuesque passing traffic. The tops of the wheels and some of the legs of the horses of this *char-a-banc*, the end of the whip-lash and the lower jaw of the conductor—who was just beginning to yawn—were perceptibly in motion, but all the rest of the lumbering conveyance seemed still. And quite noiseless except for a faint rattling that came from one man's throat!"

"I believe so. If it isn't, I've wasted my time for a year. These various preparations of the hypophosphites, for example, seem to show that something of the sort. . . . Even if it was only one and a half times as fast it would do."

"It *would* do," I said.

"If you were a statesman in a corner, for example, time rushing up against you, something urgent to be done, eh?"

"He could dose his private secretary," I said.

"And gain—double time. And think if *you*, for example, wanted to finish a book."

"Usually," I said, "I wish I'd never begun 'em."

"Or a doctor, driven to death, wants to sit down and think out a case. Or a barrister—or a man cramming for an examination."

"Worth a guinea a drop," said I, "and more—to men like that."

"And in a duel, again," said Gibberne, "where it all depends on your quickness in pulling the trigger."

"Or in fencing," I echoed.

"You see," said Gibberne, "if I get it as an all-round thing it will really do you no harm at all—except perhaps to an infinitesimal degree it brings you nearer old age. You will just have lived twice to other peoples once—"

"I suppose," I meditated, "in a duel—it would be fair?"

"That's a question for the seconds," said Gibberne.

I harked back further. "And you really think such a thing *is* possible?" I said.

"As possible," said Gibberne, and glanced at something that went throbbing by the window, "as a motorbus. As a matter of fact ——"

He paused and smiled at me deeply, and tapped slowly on the edge of his desk with the green phial.

"I think I know the stuff. . . . Already I've got something coming." The nervous smile upon his face betrayed the gravity of his revelation. He rarely talked of his actual experimental work, unless things were very near the end. "And it may be, it may be—I shouldn't be surprised—it may even do the thing at a greater rate than twice."

"It will be rather a big thing," I hazarded.

"It will be, I think, rather a big thing."

But I don't think he quite knew what a big thing it was to be, for all that.

I remember we had several talks about the stuff after that. "The New Accelerator," he called it, and his tone about it grew more confident on each occasion. Sometimes he talked nervously of unexpected physiological results its use might have, and then he would get a little unhappy; at others he was frankly mercenary, and we debated long and anxiously how the preparation might be turned to commercial account. "It's a good thing," said Gibberne, "a tremendous thing. I know I'm giving the world something, and I think it only reasonable we should expect the world to pay. The dignity of science is all very well, but I think somehow I must have the monopoly of the stuff for, say, ten years. I don't see why all the fun in life should go to the dealers in ham."

It seemed to me that Gibberne was really preparing no less than the absolute acceleration of life. Suppose a man repeatedly dosed with such a preparation: he would live an active and record life indeed, but he would be an adult at eleven, middle-aged at twenty-five, and by thirty well on the road to senile decay. It seemed to me that so far Gibberne was going to do for anyone, who took his drug, exactly what Nature has done for the Jews and Orientals, who are men in their teens and aged by fifty, and quicker in thought and act than we are all the time. The marvel of drugs has always been great to my mind; you can madden a man, calm a man, make him incredibly strong and alert or a helpless log, quicken this passion and allay that, all by means of drugs, and here was a new miracle to be added to this strange armory of phials the doctors use! But Gibberne was far too eager upon his technical points to enter very keenly into my aspect of the question.

It was the 7th or 8th of August when he told me the distillation that would decide his failure or success for a time was going forward as we talked, and it was on the 10th that he told me the thing was done and the New Accelerator a tangible reality in the world. I met him as I was going up the Sandgate Hill towards Folkestone—I think I was going to get my hair cut, and he came hurrying down to meet me—I suppose he was coming to my house to tell me at once of his success. I remember that his eyes were unusually bright and his face flushed, and I noted the swift alacrity of his step.

"It's done," he cried, and gripped my hand, speaking very fast; "it's more than done. Come up to my house and see."

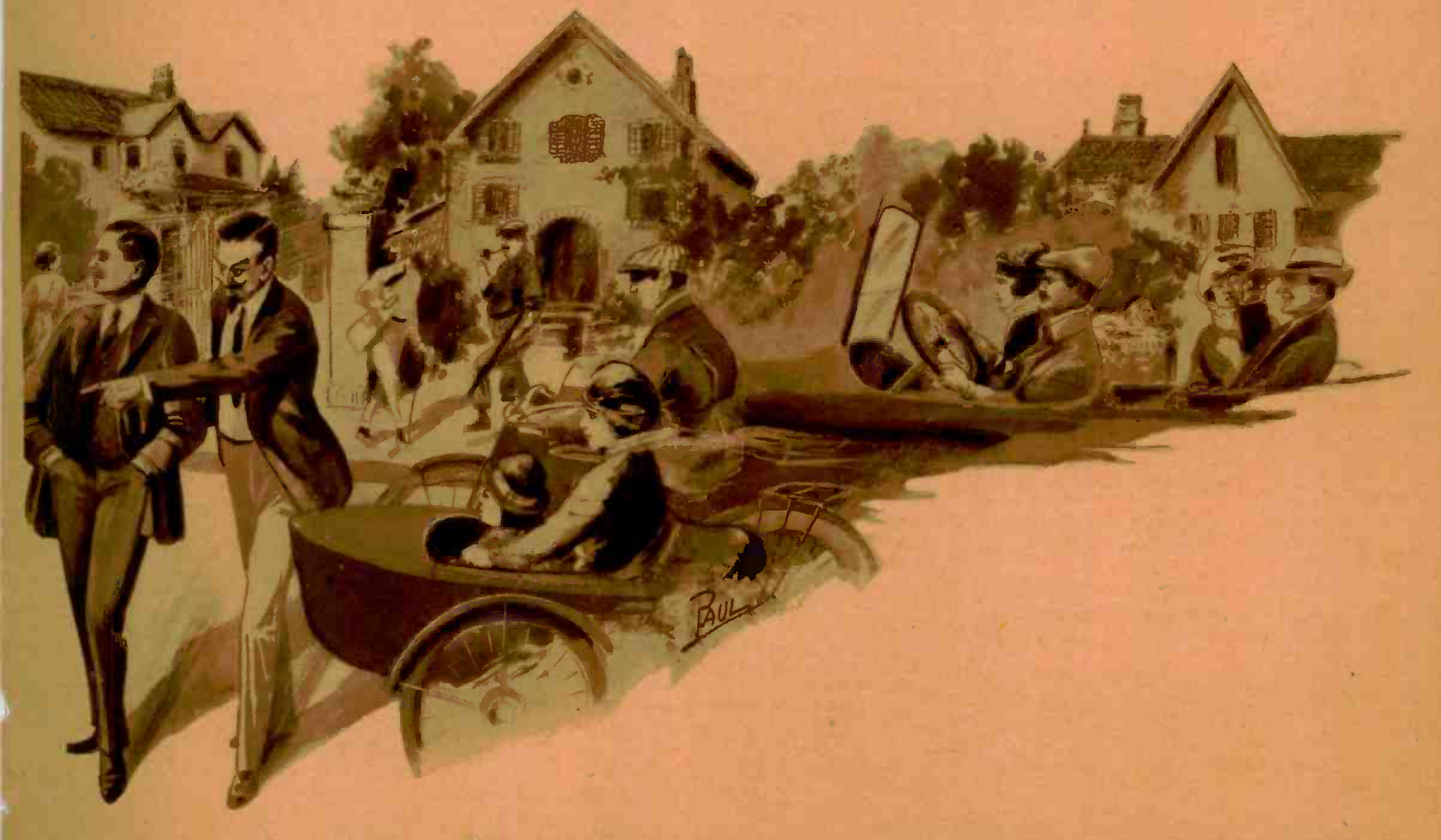
"Really?"

"Really!" he shouted. "Incredibly! Come up and see."

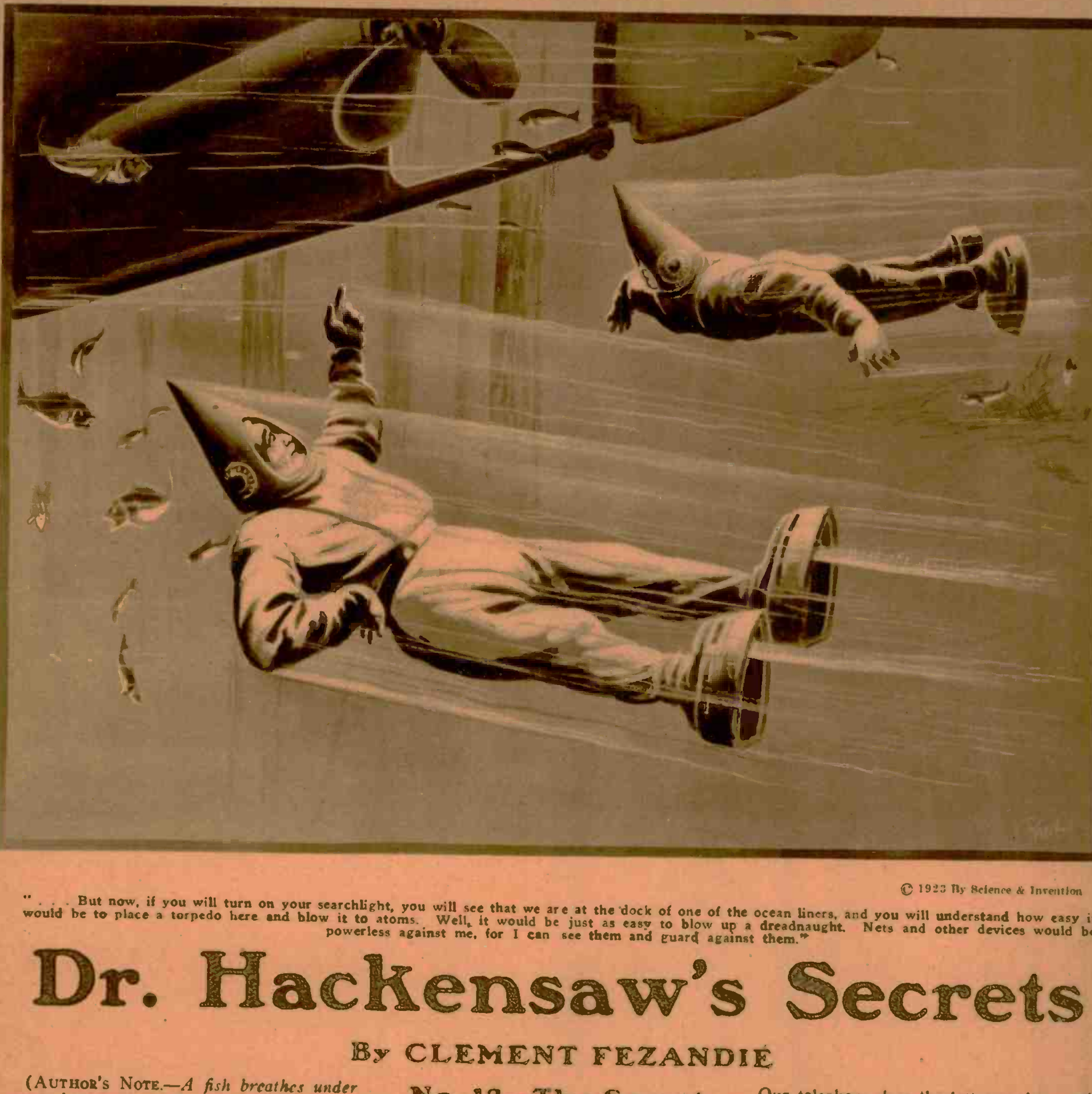
"And it does—twice?"

"It does more, much more. It scares me. Come up and see the stuff. Taste it! Try it! Its the most amazing stuff on earth." He gripped my arm and, walking at such a pace that he forced me into a trot, went shouting with me up the hill. A whole *power-bus* of people turned and stared at us in unison after the manner of people in

(*Continued on page* 1010)



"And as parts of this frozen edifice there were a driver, you know, and a conductor, and eleven people! The effect as we walked about the thing began by being madly queer, and ended by being—disagreeable. There they were, people like ourselves and yet not like ourselves, frozen in careless attitudes, caught in mid-gesture. A girl and a man smiled at one another, a leering smile that threatened to last for evermore; a woman in a floppy capelline rested her arm on the rail and stared at Gibberne's house with the unwinking stare of eternity."



© 1923 By Science & Invention

". . . But now, if you will turn on your searchlight, you will see that we are at the dock of one of the ocean liners, and you will understand how easy it would be to place a torpedo here and blow it to atoms. Well, it would be just as easy to blow up a dreadnaught. Nets and other devices would be powerless against me, for I can see them and guard against them."

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 13--The Secret of the Artificial Gills

(AUTHOR'S NOTE.—*A fish breathes under water by means of its gills, which extract the air imprisoned in the water. It should be a comparatively simple matter to devise a machine that would do the work of the gills and so enable a man to live indefinitely under water, like a fish.*)

"WELL, Silas, what do you say to a little trip in the Hudson river, today?"

"*In* the river?" echoed Silas Rockett. "You mean *on* the river, don't you?"

"I said *in* the river, and I generally mean what I say. Come along with me, and I'll show you my latest invention."

"What is it?"

"It's what you might call a set of mechanical gills. You know, of course, that, although a fish lives in the water, it cannot exist without breathing air. This air, it obtains from the wat.r itself, for a large amount of air is imprisoned in the water of brooks, rivers and even in the ocean. Place a fish in water from which all the air has been removed, and the fish will *drown*, that is to say, it will suffocate for lack of air. But every stream or pond contains air. In the stagnant ponds the air is brought down by the aquatic vegetation, in the running stream the water is aerated as it splashes through the atmosphere. A fish's gills are designed to remove this air from the water, and so allow the fish to breathe.

"Now the idea struck me that there was no good reason for allowing the fish a monopoly of the ocean. A fish's gills are by no means a complicated piece of mechanism, and I saw no reason why they should not be artificially imitated."

"Artificial gills!" cried the reporter. "You mean gills that would enable men to live and breathe under the water? Why that would be like a fairy tale!"

Doctor Hackensaw curled his lip contemptuously. "Yes," said he; "it *is* like a fairy tale, but all the fairy-tales of the olden times are becoming the facts of the present day. You read of the "Magic Carpet" that carried its owner through the air, wherever he wished to go. Our aeroplane does the same thing to-day. The old fairy tales speak, too, of a magic telescope and ear-trumpet that enabled its owner to see and hear what was happening at a distance. Our telephone does the latter, and our television apparatus will before long do the former on a scale undreamt of, even in the old stories.

"In the Arabian Nights you will likewise read of a race of men and women who could live and breathe under water. Well, with my artificial gills I can enable any man or woman to do the same thing!"

"Is it possible? That is indeed a marvelous invention, doctor. And yet, I must say, I fail to see what advantage your apparatus can have over a submarine. A submarine would seem to me far more practical and useful. The water is too cold for a man to live in it long. Then, too, there are dangers of all kinds. A submarine is a protection; it can be heated and a man can remain in it for days in comfort. While, if he were obliged to live under water, like a fish, he would have enough of the life at the end of a couple of hours."

"There is some truth in what you say, Silas," replied the doctor, "but come along with me and you can test the matter for yourself!"

* * * * *

"Here we are on board of my steam-

(*Continued on page* 1019)

Radio Controlled Mystery Ship

By GRASER SCHORNSTHEIMER, Naval Expert

EVERYONE remembers the mystery of the war, how a big British monitor was attacked successfully by a German explosive boat, which, strange to say, had no crew aboard it. Recent reports from Germany clear up the mystery.

It was the "F L Boot" or Fernlenkbaren-Boot, a distance controlled affair, which operated from the German bases along the Belgian coast. This boat, the forerunner of the present type, which is now the object of many experiments, was a motor boat of about 6 tons displacement. She was 42.6 feet long, had a beam of 6.1 feet and a draft of but 2 feet. It is to be seen that she was a fair-weather ship, unable to operate in a heavy sea. Her engines were two 300-horsepower seaplane motors located amidships. The foreward space was taken up by a very large charge of Hexa-nitro-dephnyl-sulphide, an extremely powerful explosive, developed by the Germans during the war. On the prow of the boat was a large contact detonator, which exploded the charge on even a slight collision with another object.

At first, it was supposed that these vessels were wireless controlled, as in action they were accompanied by several seaplanes, which obviously were sent at least to observe the vessel, if for nothing more. The fact is that these vessels, while distance-controlled, were not wireless controlled. At the sterns of the vessels were huge spools of single core electric cable, which connected the boats with the shore station from which they were controlled by electric impulse. However, planes spotted the movements of the vessels and reported necessary changes in course by wireless telephone. Because of this last it is believed that the Germans had the small sets of plane telephones in 1916, about two years before they were developed in the Allied services.

The new vessels are in appearance practically the same as the old ones. They carry a charge of from 300 to 500 pounds of explosive, and while the old type had a radius of action of but 12.5 miles—this was the extreme length of the controlling cable—the new ones are said to have radii up to fifty miles, due to the wireless control. A time fuse has been inserted in the bows of the boats which causes them to explode of their own accord should they fail to reach their mark and be in danger of falling into enemy hands.

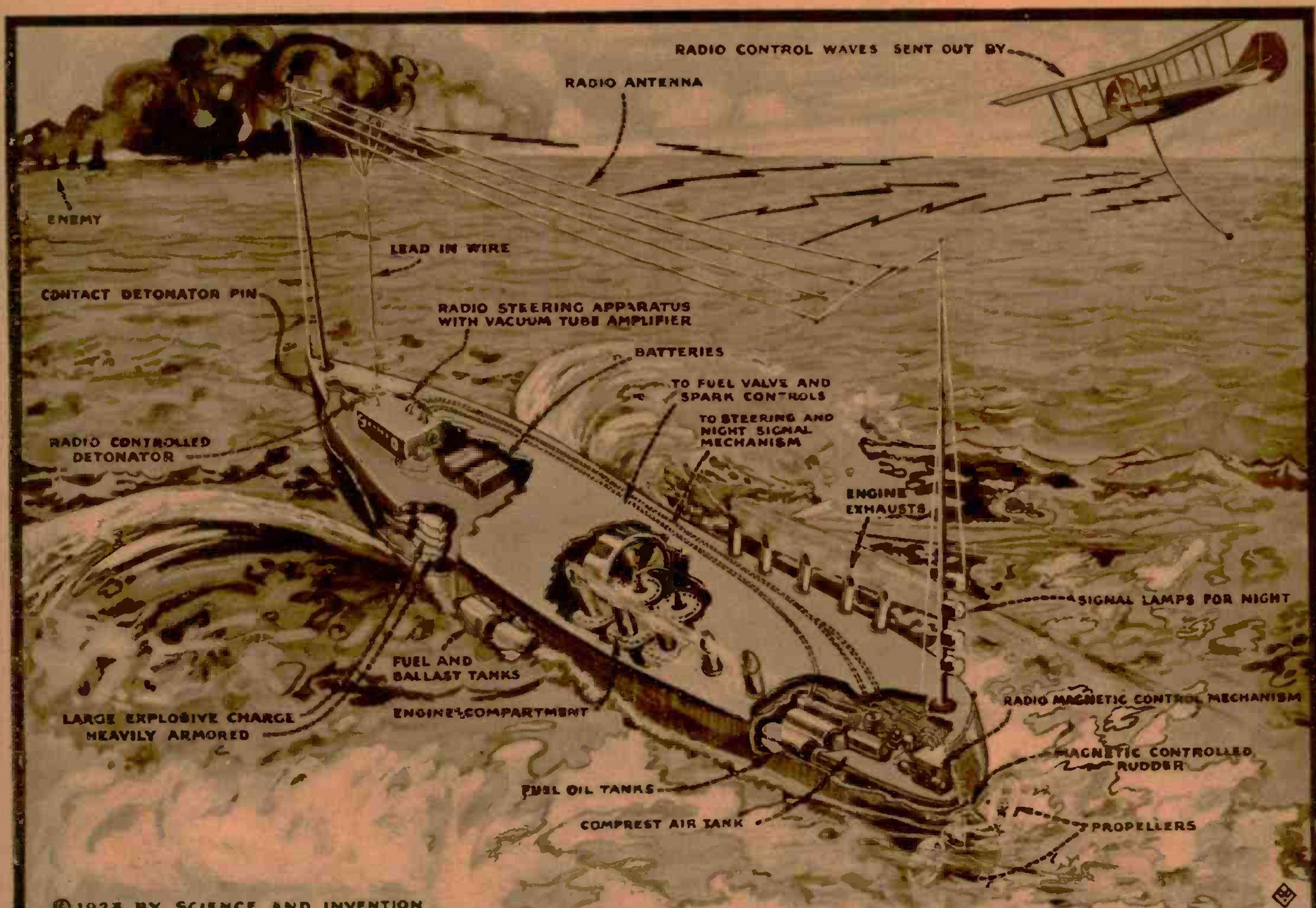
They have some very important advantages over the torpedo. The F L. Boot has, theoretically, at least, increased speeds at the extreme ranges because the load of fuel grows lighter and lighter the further it goes. The torpedo on the other hand has just so much compressed air in its tanks and as this compression goes down with the progress of the torpedo the speed is reduced.

It is said that a more advanced type is being evolved which permits control from the air.

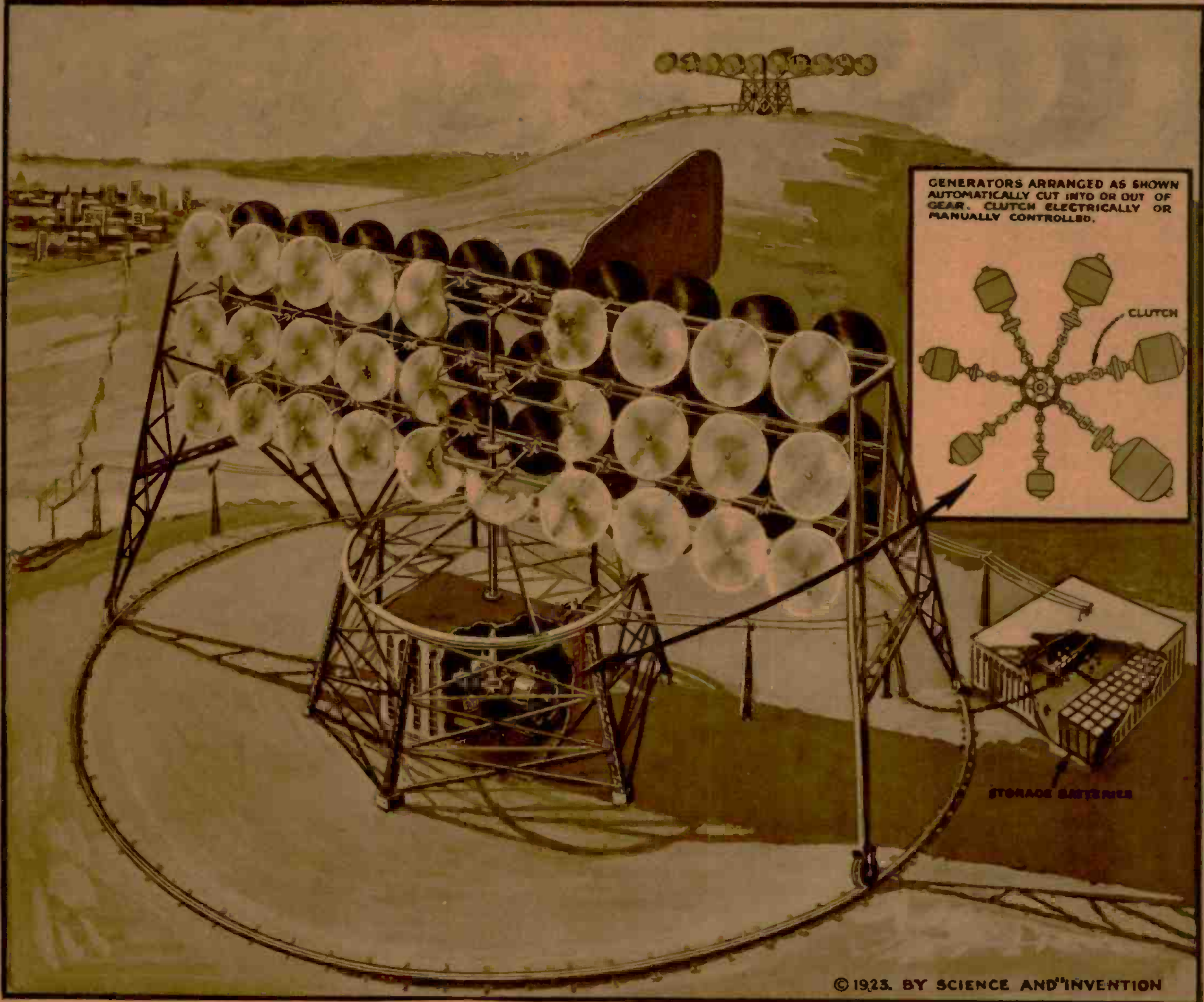
Cautions Burners of Oil in Houses

Those who contemplate making a change from coal to oil fuel should investigate the entire proposition to ascertain whether they will be assured a continuous supply of the particular fuel oil they desire to burn. Another important factor which must be taken into consideration is whether the oil-burning device to be installed meets with the requirements of local fire regulations. In connection with the supply and delivery of fuel oil it is said the various companies do not maintain the same facilities for distribution, such as will be found for distributing gasoline and kerosene.

The Standard Oil Company points out that the cost of installing apparatus to burn fuel oil, or gas oil ranges between $250 and $2,000, according to size, and if a steady supply of oil is not obtainable this investment would be virtually lost. There is something attractive in the idea of oil fuel.



In the recent World War, the Germans sprung a surprise in the form of an electrically controlled boat filled with explosives, and the direction of which was changed by electric currents sent through a cable which unwound from a drum at the rear of the vessel, the cable running to a shore control station. The latest idea in a radio controlled crewless warship is illustrated herewith, the various radio waves for changing the direction of the ship, firing the explosive, etc., being sent from a seaplane. The tell-tale signal lights at the rear of the boat indicate to the director in the seaplane, what direction the ship is taking at night



A German engineer has devised this gigantic scheme for utilizing the free power of the wind, two of his designs for huge electric plants driven by wind wheels, being shown in the accompanying illustration. The rudder attached to the frame causes the wind wheels to face into the wind with changes in its direction, the frame itself being free to revolve on wheels running around a circular track. All of the wind vanes are geared to a common shaft driving a series of dynamos through automatic clutches, the proper sized dynamo for a given wind power being automatically thrown into service, in order to realize the maximum efficiency with this type of generating plant.

A Giant Wind-Power Plant

IN countries where water is not always available for the production of power, and even the rivulets dry up, or in which due to geological and topographic conditions the flow of water is very slight and dams cannot readily be built, other methods of obtaining power without using coal must be employed. Electricity produced from coal is subject to limitations, because in the course of time coal mines will be exhausted. Coal mining is also a rather expensive procedure, and transportation charges bring up the price of coal considerably, as do strikes among miners and railroad operators.

Air currents on the other hand form a most reliable and inexhaustible source of power, even though the speed of the wind rises and falls, decreasing almost to zero at times, and increasing to a gale at others, and although small wind-driven generators are being employed for producing electrical energy on farms, these plants are not as economical and efficient as large wind motors, having many fan wheels arranged side by side, one row above the other, and one group behind the other on a structure capable of withstanding heavy wind velocities, transmitting the accumulated power to a common shaft.

A German engineer, Herr Carl Ludwig Lannenger, has shown how such giant wind motors could be employed for producing electrical energy in large quantities. Not only could they be erected on windy beaches, but also in the inland regions or on hills or wide flat grounds. The individual fan wheels on such large motors would vary in diameter from twenty to forty feet, with an extreme diameter of possibly fifty feet. In the illustration two of these giant wind power machines are shown. In the foreground is a wind mill which has three rows of fan blades arranged, one above the other, and another set, exactly identical backing this. There are, therefore, six rows of these immense air wheels.

The entire structure rotates on a structural central upright, a large vane serving to direct the bladed wheels into the wind. The end of this rotating structure likewise turns on rollers, which bear on a circular track. In the background we see another power plant of a similar nature, having only one double row of fans. This is a smaller power station, and it will be seen that the structure here revolves on the center upright, having no additional braces and no circular tracks, as in the case of the aforementioned power producing devices.

Now, usually the velocity of the wind on beaches and in the inland regions varies in speed from three to eighteen miles per hour, but because of the variation of speed corresponding as it does to a definite number of revolutions of the power shaft, and also to a definite torque, the giant wind motor does not drive only one dynamo for charging the accumulators, as in the case of small wind-driven generators. In the large central stations, the changing forces of the wind are classified in certain groups, and for each group a corresponding dynamo, which is automatically switched into or out of the circuit, is employed. For this reason, the highest efficiency of the dynamo is obtained at any given speed or power. As no generator will develop its maximum amount of power, unless driven at a certain speed, and if a generator is designed so that it can operate efficiently on one of the speeds, a governor must be employed to cut down

(*Continued on page* 1017)

Real Snow Storms for Theatres

FOR many years the theatre-going public has witnessed snow scenes as produced on the stage, in which bits of paper were dropped from one of the fly galleries to be blown about by electric fans, giving the appearance of snow storms, but this snow fell far short of the mark, when attempts to sweep it up proved to the audience that it was merely paper.

An enterprising inventor has at last designed a very simple method of producing real snow for winter scenes which in addition to its fluffy nature adheres to the coats and wraps of the actors or actresses just like natural snow. When the entertainers enter a warm cabin, all of the snow is not shaken from their coats as in the case of paper, but part of it remains, and as it melts a puddle of water forms. So simple is the apparatus that it is surprising that no attempt to build a similar device has heretofore been made.

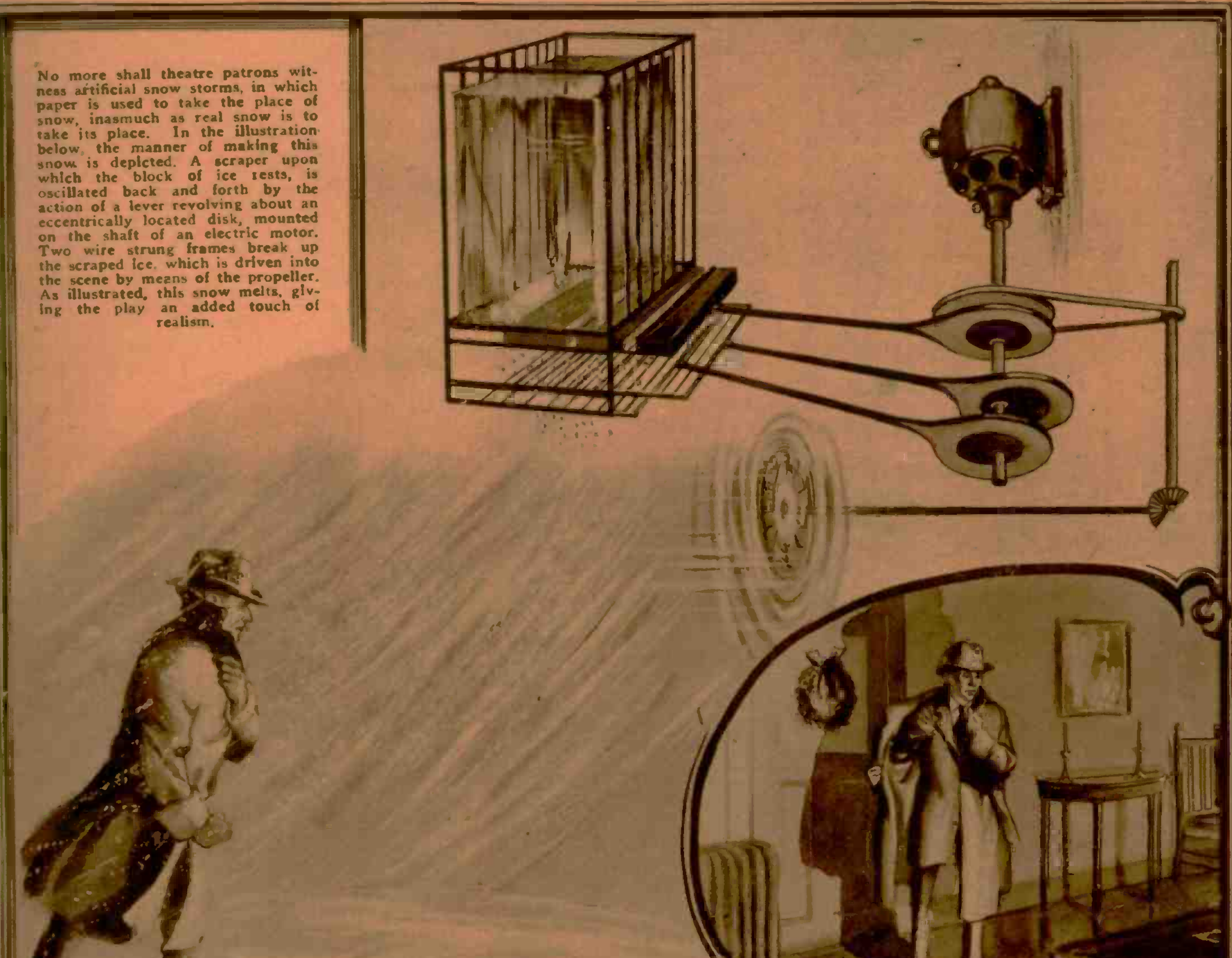
The device suspended or erected on one of the fly galleries, consists of four upright bars which act as racks to guide a cake of ice, which is inserted into the receptacle thus formed. This cake of ice rests on a platform, the bottom of which has several shaving knives embedded in its surface. The platform likewise has a number of slots located adjacent to the knives through which the shaved ice may fall. An electric motor driving a long shaft, causes this knifed shaver to oscillate back and forth, by reason of the fact that it is connected by a rod to an eccentric mounted on this shaft. Immediately beneath this there are two racks made of wood also actuated by eccentrics mounted on the same shaft. The frames are strung with a number of piano wires giving each bar the appearance of a musical instrument, across which strings are tightly stretched. These bars, oscillating as they do, cause the shaved ice to be broken up and distributed. An electric fan also driven by the same motor agitates the snow thus formed, causing regular snow flurries.

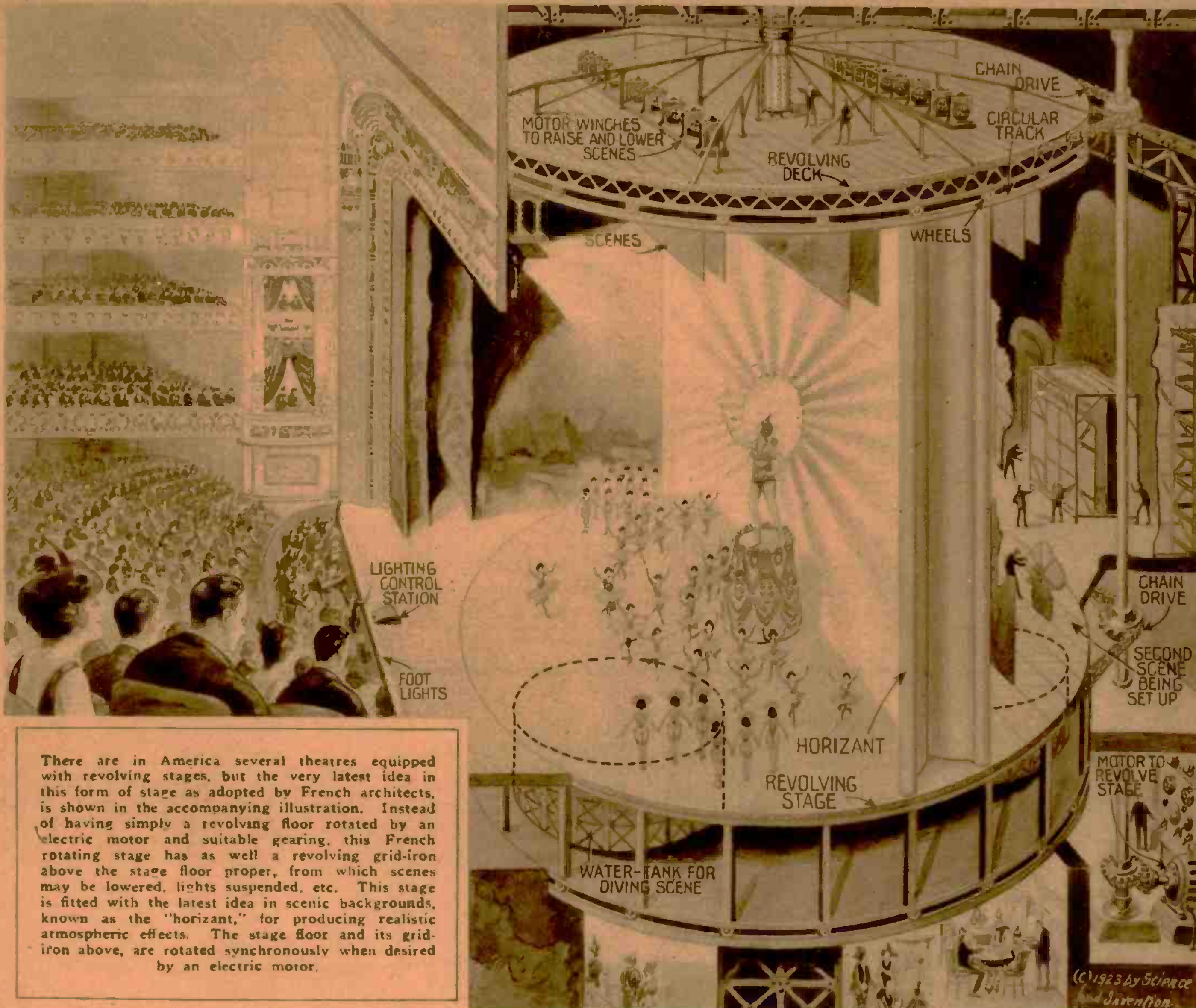
So simple is this construction, and so realistic are the effects which can be produced by this device, that there is no doubt but that some enterprising theatrical producer will employ the system in a production depicting winter life within the forthcoming season.

Of course there are several disadvantages which this machine produces. An actress could not enter a scene such as the one shown here, in a pair of high heeled silk pumps, without causing them to either lose their shape or become wet. Neither could she use a silk cape. but when one analyzes the situation, he finds that the star should not be wearing French shoes in a scene of this nature. The storm calls for heavy garments from the shoes to the hat, not merely a thin lace dress, fancy pumps, and a coat covering the costume so that it will represent a winter scene. In other words, we get more realism even with regard to the attire. The next problem which presents itself, is the removal of the snow from the scene. This is easily accomplished by covering the floor of the stage with a sheet of canvas or rubber, so as to make it impervious to water. By the time the curtain is to fall, unless the storm is continued during the entire scene, the snow will have melted and it can then be removed in the form of water by rolling up the canvas, and tipping it on a side, permitting the contents of the chute thus formed to pour into a tub provided for that purpose.

For indoor scenes with a snow storm raging without, the performer who is to enter the scene after passing through the blinding storm could stand beneath one of these snow machines, and after having received a generous coating of the white flakes, could enter the scene, and shake real snow from his mackinaw, and stamping his feet vigorously could shake off the particles from his boots.

No more shall theatre patrons witness artificial snow storms, in which paper is used to take the place of snow, inasmuch as real snow is to take its place. In the illustration below, the manner of making this snow is depicted. A scraper upon which the block of ice rests, is oscillated back and forth by the action of a lever revolving about an eccentrically located disk, mounted on the shaft of an electric motor. Two wire strung frames break up the scraped ice, which is driven into the scene by means of the propeller. As illustrated, this snow melts, giving the play an added touch of realism.





There are in America several theatres equipped with revolving stages, but the very latest idea in this form of stage as adopted by French architects, is shown in the accompanying illustration. Instead of having simply a revolving floor rotated by an electric motor and suitable gearing, this French rotating stage has as well a revolving grid-iron above the stage floor proper, from which scenes may be lowered, lights suspended, etc. This stage is fitted with the latest idea in scenic backgrounds, known as the "horizant," for producing realistic atmospheric effects. The stage floor and its grid-iron above, are rotated synchronously when desired by an electric motor.

Novel French Revolving Stage

REVOLVING theatre stages are not new to American theatre-goers as they have been known and used here for many years, but one of the most unique is that here illustrated, and which is used in several French theatres. One of the leading New York playhouses—the *Century*—has a large revolving stage on which two or more scenes may be set simultaneously, to be brought into view one after another for the different scenes or acts. But the scenes hung from the fly gallery do not rotate with the turn-table stage, as they do on the French stage here illustrated.

To avoid building a cumbersome and awkward rotating structure seventy feet high or more, in order to turn the fly gallery or grid-iron, as it is usually called in theatre parlance, an ingenious scheme of revolving the circular stage floor and the grid-iron synchronously, was evolved by the French architects and engineers. As shown in the picture a vertical shaft at one side of the stage and of sufficient strength is arranged so as to turn both the stage and the grid-iron above the stage, by means of two sprockets and large chains, the shaft itself being driven by another sprocket and chain, or else by gears in some cases, which connect with a suitable electric motor. When the signal is given the stage electrician operates the proper switches, and the stage and its grid-iron rotate in step with one another. Drop lights, scene drops, *et cetera*, are suspended from the grid-iron and these are raised and lowered as desired, by a series of electric winches, as shown in the illustration. This grid-iron is a very substantial affair and rotates on a series of rollers or wheels, arranged around its periphery which bear on a circular track supported by suitable girders. The center of the rotatable grid-iron is arranged on an extra large pivot suitably braced and supported. Electric current is supplied to the grid-iron for the motor winches used in raising and lowering scenes, lights, etc., by means of flexible cables, or else through a commutator ring and brush arrangement.

This revolving stage does not consist merely of a floor which can be revolved as desired, by simply pressing an electric button, but it consists of a double floor arrangement with quite a space in between the floors suitable for accommodating framework for various water tanks, etc., which may be necessary in certain scenes, for example, where people dive into the water. This revolving stage is fitted with two or rather a double type *horizant*, which is coming into popular use nowadays, as it gives very pleasing sky scenes, the sides and top of the horizant being curved, so as to give a natural sky effect. These horizants are usually made of plaster on a wire lath or equivalent frame or reinforcement. At the front of the stage a series of electric control buttons are situated, so that the revolving sections can be actuated if desired from this location. The stage manager is located in a small compartment, the top of which is almost flush with the stage, the rear side of this compartment being open, so that he can see the actors and the scenery readily.

Telephone communication is provided between the stage attachés on the revolving grid-iron and the stage manager, below so that orders can be given for changes in scenery, etc.

The Secret of the Old Italian Violins

By Dr. ALBERT NEUBURGER

THE secrets of the old Stradivarius and Amati violins have been occupying the minds of musicians for centuries and have given a great deal of work to chemists and other investigators. These investigators have taken up the subject of the methods of the old violin constructors, have searched in their houses, trying to discover, perhaps, in a small corner, some recipe for the varnish with which they worked, and have tried to find the places whence they got their wood. This wood has been analyzed more than once, and it seemed very possible that the timbre of the violins was due not only to the species of wood, but the part of the trunk from which it was taken, and again it is possible that age might have been a factor. Experiments have been made recently by the scientists of the Experimental Station for Cellular Tissue and Wood in Germany, but they were unable to solve the problem definitely. Sample violins were constructed out of wood more than a century old, but the result was not satisfactory. The varnish contained rosin, flaxseed oil, and turpentine, yet the combination did not seem to have always been the same. Sometimes no rosin was present. It is possible that the varnish contained elements that volatilized in the course of time, or that the varnishes originated in a country where they had different qualities from those possessed by present samples.

High prices were paid for the few old violins the origin of which could be certified as objects to be studied, but it was not possible to imitate the old ones. Forgeries of every kind appeared.

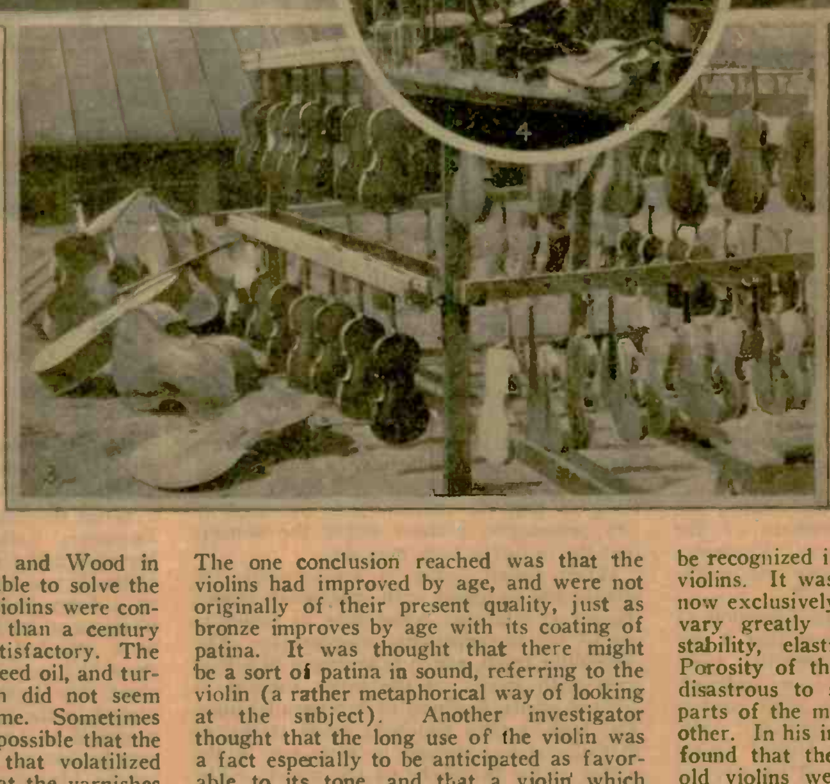
The synthetic method of attacking the problem was chosen. One experimenter tried to copy the old existing violins by measuring their dimensions and following them with great exactitude. Wood was taken from the native country of the constructor. All kinds of different varnishes were tried, but nevertheless the new violins never reached the beautiful timbre of the old ones, though they certainly did indicate progress.

The experiments were continued. Bridges were changed, various sorts of glue were tried, and many new experiments were made. The one conclusion reached was that the violins had improved by age, and were not originally of their present quality, just as bronze improves by age with its coating of patina. It was thought that there might be a sort of patina in sound, referring to the violin (a rather metaphorical way of looking at the subject). Another investigator thought that the long use of the violin was a fact especially to be anticipated as favorable to its tone, and that a violin which has been silent for a couple of years loses its quality. It has even been regretted that Paganini left his celebrated violin, after his death, to Genoa, his native town, where it is kept carefully in a museum, and is never played upon. It is believed that perhaps the violin may lose its quality.

A new method has been evolved, however, which is different from anything ever tried, and which has met with considerable success. Professor J. F. Koch came to a conclusion. He was a physicist, gifted with a sense of music that is given only to a born musician. He maintained that if it had been possible some 300 or 400 years ago to attain the ideal quality of timbre with the acoustically effective parts of the instrument well known to us, it would also be possible today to come to the same result, if one took the same care in working and handling the proper materials. Professor Koch concluded that the tone was due to the material used, and that the dimensions of the instrument had little to do with it. After examining the old violins with a microscope he began to allude to their *homogeneity*. The wood showed a strikingly homogeneous structure, which could only be caused by a certain way of treating it before it was varnished, so it was decided to treat the wood with a substance very like the one that could be recognized in the wood of the old Italian violins. It was found that pine and maple, now exclusively used in constructing violins, vary greatly in regard to their weight, stability, elasticity, and other properties. Porosity of the woods seems to be utterly disastrous to sound, causing the different parts of the material to vary, one from the other. In his investigations, Professor Koch found that the pores of the wood of the old violins were filled with a transparent substance, giving the wood a horn-like structure, and by impregnating the pores of the wood with a species of filler, made up with drying oils, he seemed to reach, at last, a result comparable to that obtained by Stradivarius and his successors, who are almost his rivals.

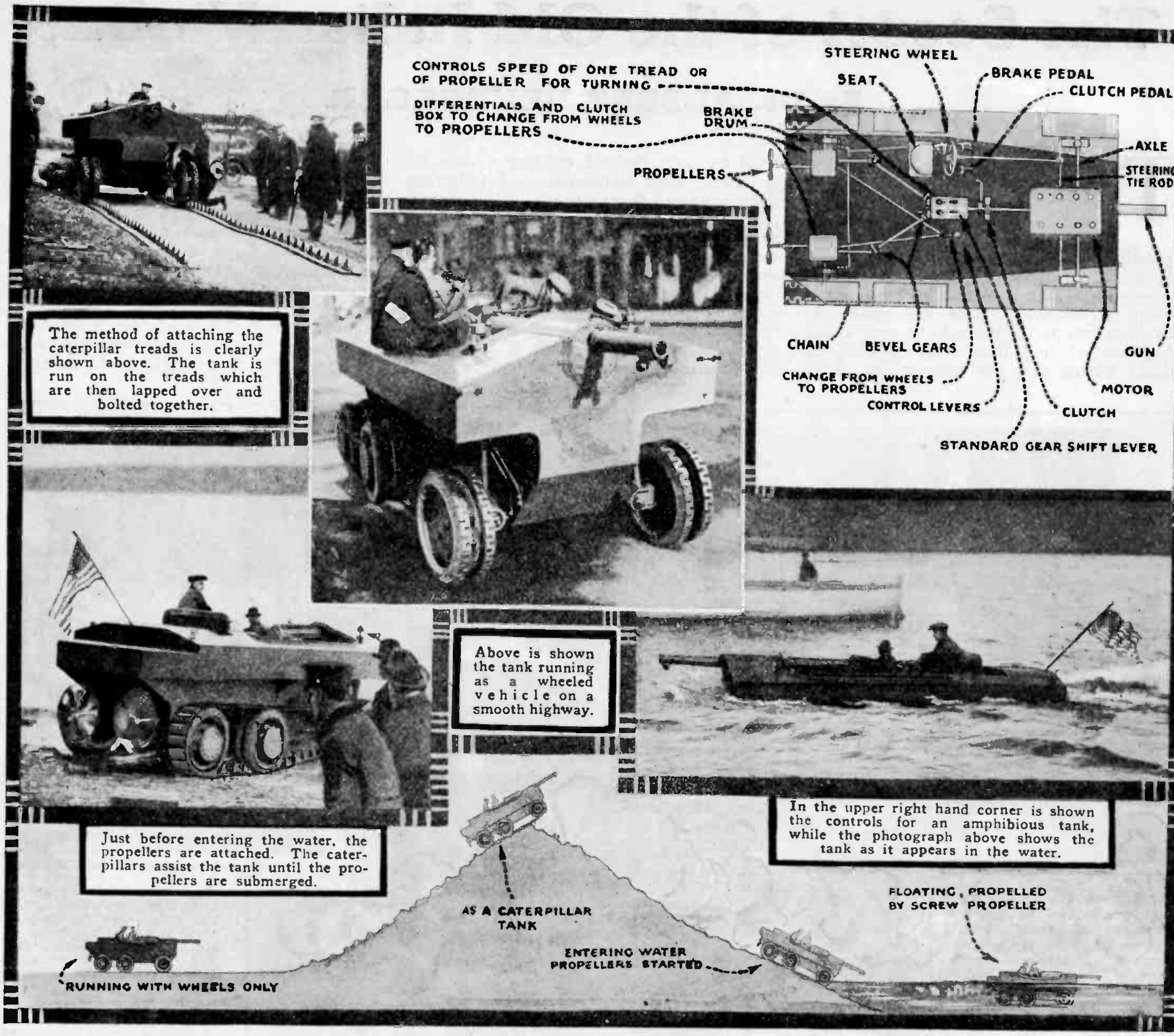
With the instrument thus treated, there was observable in sections of the wood the transparent appearance of an old violin,

(*Continued on page* 1018)



For years budding violinists have been told of the famous Stradivarius, Amati and Guarnerius violins for which fortunes have been paid. But none of these could rank with a modern Koch-made violin, only a year or two old, as tests proved.

An artist is shown at the left playing on a violin while the judges are deciding on their choice of the best. A Koch modern violin won. Fig. 2 shows the instruments being treated, and Fig. 3 shows a number being dried in the sun. Fig. 4—Prof. Koch himself.



The method of attaching the caterpillar treads is clearly shown above. The tank is run on the treads which are then lapped over and bolted together.

Above is shown the tank running as a wheeled vehicle on a smooth highway.

Just before entering the water, the propellers are attached. The caterpillars assist the tank until the propellers are submerged.

In the upper right hand corner is shown the controls for an amphibious tank, while the photograph above shows the tank as it appears in the water.

An Amphibious Battle Tank

By A. P. PECK

AN extraordinary battle tank was recently demonstrated before representatives of the War and Navy Departments of the United States, and several hundred members of the American Society of Mechanical Engineers in New York City and directly across the Hudson therefrom.

This new tank which is the invention of Walter Christie, is so designed that it can be used either as a wheel or caterpillar tank, or as a boat. It can navigate any ordinary stream, river, or inland lake with perfect safety and comfort to its occupants. Mr. Christie is President of the United States Mobile Ordnance Company, and has several other inventions and improvements on tanks to his credit.

The tank itself, which is shown in the accompanying photographs, is a formidable looking affair mounting a 3-inch gun on its forward end. Six wheels carry this seeming monstrosity, the two rear pairs of wheels being connected together by means of sprockets and chains, as shown. A steering wheel is arranged to manipulate the front wheels when it is desired to drive the machine as a wheel tank. When being driven in this way it is capable of making twenty-five to thirty miles an hour on a smooth road. The wheels are equipped with heavy rubber tires, so that the machine may be used on city pavements, without doing the damage that the ordinary tank may do.

When rough going is encountered, the wheels are equipped with caterpillar treads, the actual attaching being done as shown in one of the accompanying photographs. The caterpillar tread, which is arranged in a long strip with spikes on the inner surface, is laid out on the roadway in two parallel lines. The tank is then run over these strips, so that the spikes engage in slots cut in the center of the periphery of the wheels. The strips are then brought over the tops of the wheels and bolted together, whereupon the machine is ready to travel the roughest of terraine. This change can be done by trained men in the space of a very few minutes.

When the tractor is being run in this way, the steering is done by means of variable gears, which drive one side either faster or slower than the other, thereby, of course, causing the tank to turn. The transmission boxes for this work and the lever for controlling a tractor of this type are shown in the accompanying illustration. These transmissions are also used when it is desired to propel the vehicle through the water.

When on demonstration, the tank left the Engineers' Building in New York City, and traveled under its own power up Riverside Drive. It was transported to the Jersey shore on a ferry boat, where it was put through its paces on land. Here the caterpillar treads were attached and the tank started up a steep incline. As it struck a forty per cent. slope, the treads slipped and spun for a second in the soft mud, and for the instant it looked as if the tank were going to topple over backwards into the river. The field gun on the forward end pointed almost directly to the zenith, and the machine veered dangerously. In a moment, however, it regained its equilibrium, and started up the steep grade with the same alacrity that it displayed on the level. The occupants of the tank, however, had some trouble in keeping their seats, and it was necessary to hang on tightly in order to keep their places, and prevent themselves from falling out backward. The machine climbed for a distance

(Continued on page 1029)

New Light Effects in the Theatre

By LUCIEN FOURNIER, Paris Correspondent

THE great masters of the theatrical art are scenery and light; the text of a play, the music, make no special appeal to us, because they are accessories used only for giving a value to the two sovereign powers, whose harmony soothes us and raises us above reality. Without them no work, however powerful, could produce its due effect, and thanks to them mediocrity seems sometimes to attain the sublime. When electricity took its place on the theatrical stage, it brought with it an absolute revolution in the lighting effects, but up to this time scenery has had little development. These are always country scenes, fragments of nature, whose attempted realization has not always the most happy effect. They are all fragile accessories and in unstable equilibrium, on which progress has so far had no effect.

It took twenty years for a French savant, who was endowed with high artistic ability, Eugene Frey, to develop a method which brought about a revolution in theatrical scenery. It was experimented with in the Opera House at Paris, in the Opera Houses in Monte Carlo and in London, and in La Scala in Milan and in La Monnaie in Brussels, with extraordinary success. The test had succeeded. The old time canvas scenery painted with castles, lakes, and forests, yielded finally to painting upon glass, to the colored lantern slides of standard dimensions, whose images were projected on a white screen. The cinematograph could not solve this difficult problem, because it is the slave of the moving film, and because the scenery in a theatre can only be changed at the proper periods according to the action of the piece.

The following is the principle on which it is carried out. The stage at the rear is cut off at a certain distance from the footlights by a great white cloth screen, which has been washed over with an application which makes it translucent. Viewed from the front, the curtain constitutes the scene properly so called, and the space behind it is occupied by a variable number of projection lanterns, into which are inserted by hand at the proper moments, the glass positive lantern slides of standard size, and representing the scenery in bright colors. The lanterns magnify the images 10,000 to 16,000 times, so that each one of them covers the entire surface of the curtain, which may be of nearly two hundred square yards area. The spectators, therefore, see the images by transmission. The projection is made upon the rear face of the curtain. The water color which we reproduce, which represents the Cavalcade of the Valkyres, shows clearly the application of the process. The arrangement of a theatre of the present day is not adapted for the introduction of the new process, unless it can receive certain changes with reference to the lighting of the proscenium. It is necessary that the rays of light coming from all the stationary lamps, shall not impinge directly on the curtain, for then their light would greatly impair the projections of the lantern slides. Mr. Frey arranges these lights so that they leave the curtain in a sort of penumbra, favorable to the view of the images projected upon it, and, due to which, the curtain itself appears brilliantly illuminated.

We now come to the scenes proper.

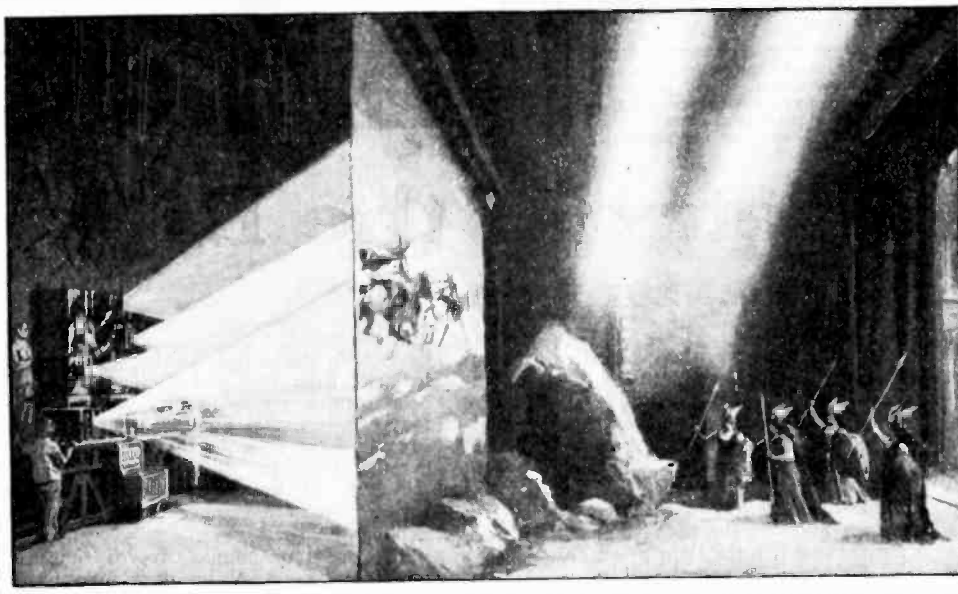
The inventor first paints with *gouache* the outlines of a scene in sufficient detail to serve during the duration of an act, for giving the dimensions in proper reduction in black and white on bristol board. This proof is very exact in its smallest details as it has to serve as a base in the preparation of the lantern slides which are to be placed in the projection lanterns.

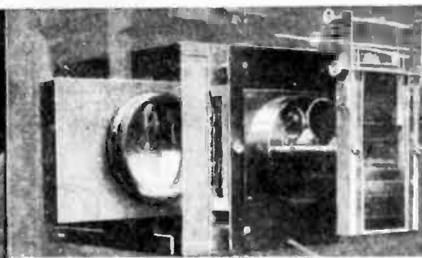
A negative, 3½ by 5 inches, is made from this gouache picture, the positive from which is afterwards printed, which is subject to all desired changes. Each of these positives is then finished by the application of colors by hand, to give the necessary scenic effects.

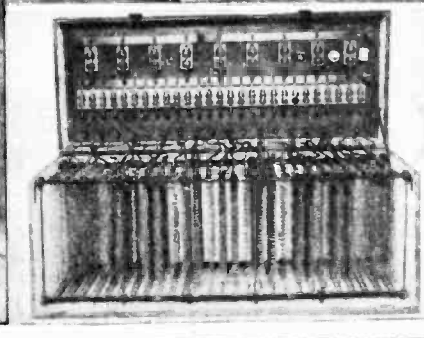
We have, for example, a group of six lantern slides, which will make the principle of the process perfectly clear.

The first shows a winter scene; snow covers the trees, the ground, and spreads over a frozen pond. It is painted with the typical model as a base, which model gives the skeleton or outline of the country to bring out a winter scene. The second view shows

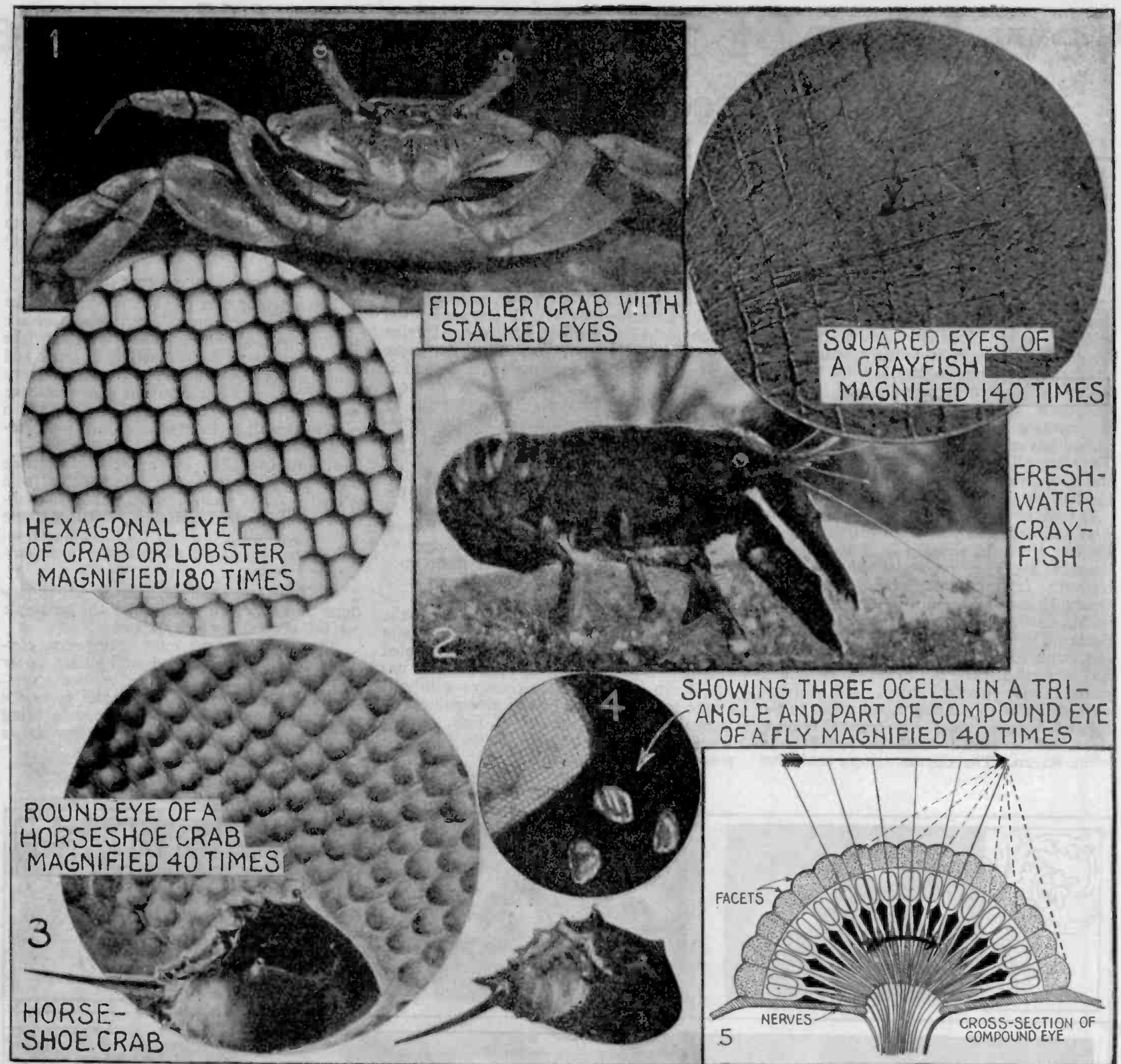
(*Continued on page* 1006)







The latest idea in stage settings and scenic effects as practised in French theatres, is here shown. Instead of having painted scenic back drops, the stage at the rear is cut off by a translucent white cloth screen. The space behind this curtain is occupied by a set of special projecting lanterns, in which slides are placed containing the various scenes. By special focusing and lens shifting mechanism, as shown in the picture of the projector at the right, the various scenes can be dissolved into one another. The lower right-hand view shows rheostats used in controlling the electric lights in the projecting lanterns. The three top pictures show horses galloping, as introduced in the "Cavalcade of the Valkyres."



The geometry of the eye as practised by Mother Nature, is clearly shown in these exceptional photographs taken by Dr. Bade, the author of the present article. Fig. 5 shows a cross-section through a compound eye showing lens, pigments, and nerve-ends and rods which are visually active. The large arrow is the object seen, the smaller one the image. The straight lines represent the rays of light coming from the arrow and entering the cells or facets of the eye which give the image. The dotted lines are other rays entering the facets from different angles but held back from entering the nerve ends by the pigment.

The Geometry of the Eye

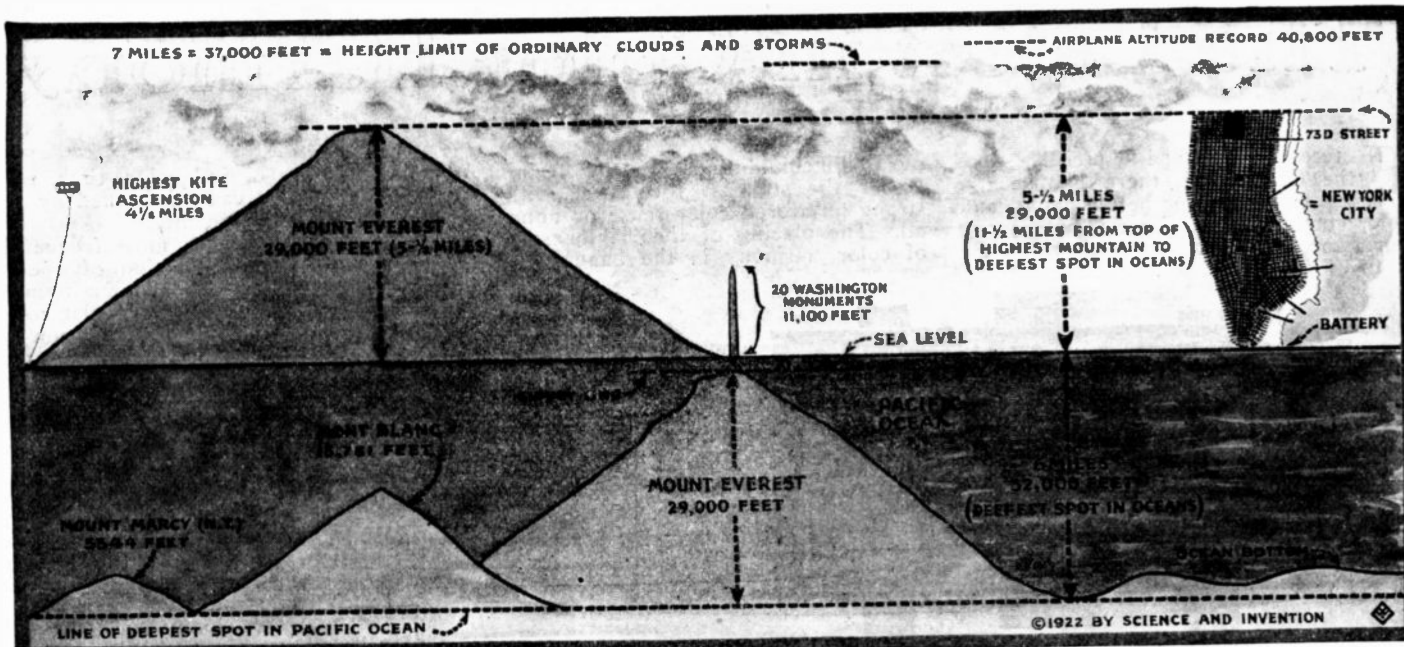
By Dr. ERNEST BADE

OF all those many senses in the animal kingdom, none are so diverse as the organ of sight. Its development is partially based upon the height that the creature may have attained as well as the mode of life of the individual considered. There is no bridge which links the eye of the vertebrate with the eye of the invertebrate, in fact there is not even a similarity in structure. The eyes of the latter agree only in so far as they originated from the outer skin; in all other respects the optical cells of the invertebrates are exceedingly diverse. All have developed from pigmented cells sensitive to light. In the lowest organized creatures they are more or less closely united to the cells of the ectoderm and even here some have been able to develop light refracting organs.

As the lowest forms of life are approached the simpler does the organ of sight become, and the most primitive of these are only able to distinguish light from darkness. In general an eye is not even necessary for this purpose, the outer skin being able to take up this function. But its effectiveness is increased where sight is restricted to various parts of the body so that the direction from which the light or shadow appears can be better judged. Still more effective does this primitive eye become when a dark pigment surrounds the nerve-end, thus keeping away all side light, and it is still better when a lens is formed which is imbedded in a pigmented cavity as the light-rays must then pass directly from in front of the lens, through it, to the nerve-end beneath. It is in this order that the organs of sight have been developed in the jelly-fish, turbellaria, flatworms and snails. At first an open capsule seems to predominate, then a glassy cavity, and finally a lens is formed. Mussels have their eyes on the edge of the mantle, while the star fish have theirs at the ends of the rays, and the regularly formed sea urchins have rows of them encircling the shell.

The ocelli or simple eyes of the insects are also primitive in their organization. They have developed from a thickened inner cellular layer lying beneath the chitinous cuticle and partitioned from neighboring cells where they form a round or oval cavity. As organs of sight these ocelli are far too much restricted in every way, they are primarily stabilizers which keep the body of

(*Continued on page* 1004)



This picture-diagram shows in an interesting manner the comparative great depths and elevations of our globe. The maximum airplane altitude height is also shown, far above Mount Everest, or 40,800 feet above sea level. The figures of Mount Marcy, Mont Blanc, and Mount Everest, are shown superimposed below the sea level line, to give a comprehensive idea of the greatest measured depth in the Pacific Ocean of six miles.

From Ocean Depths to Mountain Heights

By CHARLES NEVERS HOLMES

HOW magnificent is the ocean! How majestic is the mountain! The former lies restless in its mighty mould, the latter looms motionless amidst wooded vales. Ocean or mountain, both are equally glorious.

Yet not wholly for their grandeurs are these creations of nature remarkable. They possess a prosaic as well as a poetic significance. They have height and depth, length and width. They are fluid or solid. The ocean or the mountain contains different molecules made up of invisible atoms combined in certain definite proportions.

There are five major oceans. There are many lofty mountains. We all know that the major oceans are named Pacific, Atlantic, Indian, Antarctic and Arctic. All of us do not know that the Pacific Ocean possesses about 68,000,000 square miles and the Arctic Ocean about 4,500,000 square miles. We all have heard of Mount Washington, Pike's Peak, Mont Blanc, Aconcagua, and Mount Everest. All of us have not heard of Mount Guyot, Granite Peak, Mont El Bruz, Mercedario, and Mount Godwin-Austen.

The deepest spot in the Pacific Ocean is very deep. The highest point in the Himalaya mountains is very high. The deepest known spot of terrestrial oceans is off Mindanao, Philippine Islands. This lies about 32,000 feet below the surface. The highest known point of terrestrial lands is, of course, Mount Everest. This rises about 29,000 feet above the ocean surface.

And, between these 32,000 feet of oceanic depth and these 29,000 feet of mountainous height, there are innumerable depths and heights of oceans and mountains. For example, the average depth in the Pacific approximates 2,100 fathoms, which, multiplied by 6, equals 12,600 feet. Also, the average depths in the Indian, Atlantic, Antarctic and Arctic oceans approximate, respectively, 12,000, 10,800, 9,600, and 9,000 feet. If we add these five depths together, and then divide their sum by five, we obtain a general average of all our major oceans—10,800 feet. Thus, it is evident that the average depth of Pacific, Indian, Atlantic, Antarctic and Arctic oceans approximates a little more than two miles.

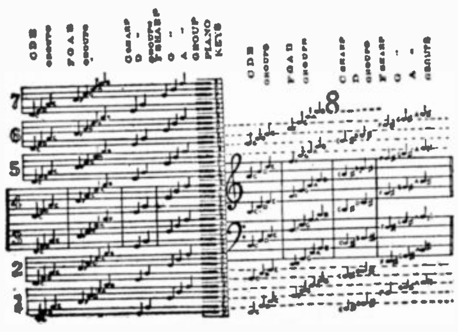
There are six continents upon our earth's surface. The continent possessing the lowest elevation of terrestrial mountains is Australia—Mount Kosciusko being only 7,777 feet in height. In Europe, Mont El Bruz rises more than 18,000 feet; in Africa, Kibo Peak ascends more than 19,000 feet; in North America, Mount McKinley exceeds 20,000 feet; in South America, Aconcagua is about 23,000 feet; and, in Asia, Mount Everest towers 29,000 feet above sea-level. Accordingly, the average height of these six grand mountains, each of which crowns one of our world's continents, approximates 19,000 feet, or more than three and one-half miles.

Thus, were we able, we could descend 32,000 feet to the ocean's bottom or 29,000 feet to the mountain's top. That is to say, it is about 384,000 inches to that deepest spot off the Philippine Islands, and 348,000 inches to the summit of Mount Everest, in India-China. Now, if a body should sink below the surface of the Pacific Ocean at its deep spot, descending at a rate of one foot in six seconds, such a body would reach that ocean's deepest spot in about 53 hours. And, if we could climb Mount Everest, ascending at a rate of one foot in six seconds, we should stand upon its top in about 49 hours. That is, were there no difficulties in our way, we could climb, at the rate mentioned, from the bottom of the Pacific Ocean to a height equaling that of Mount Everest, within about four and one-quarter days.

The total distance in a perpendicular line from the Pacific's bottom to a height equalling that of Mount Everest's summit approximates 61,000 feet. In other words, about eleven and one-half miles. Now, a man, walking three feet per second, could cover that distance in about five and two-thirds hours. That is, on a level surface. But no man, as far as we know, has been able to climb from the ocean shore to the top of Mount Everest. Indeed, it is possible that he will reach Mount Everest's summit on an airship before he arrives there on his feet. Were all the water to disappear from the Pacific Ocean, and were one of us to travel from its deepest spot to earth's loftiest crest, such an individual would have to walk and climb, approximately, 3,000 miles. Thus, the deepest known ocean depth and the highest known mountain height are situated within a few thousand miles of each other.

New Music Staff

Is there anything wrong with the old-style music—the old natural music staff? Being so used to it at the present day, we scarcely notice that music written on the old-style staff should now be discontinued. We really should have something better. It is quite evident that when a pupil on either the violin or the piano starts to read notes above or below the "Treble" and "Base" clefs, notes near the extreme lower points of the scale and above the staff are very difficult to decipher. Even to experienced players this difficulty is an ever-present fact, because in the fraction of a moment a number of lines has to be counted up, leading to that note and the note struck correctly. Of course, years of experience make this easier, but what about the new pupils? They always have difficulty on reading these higher and lower units.



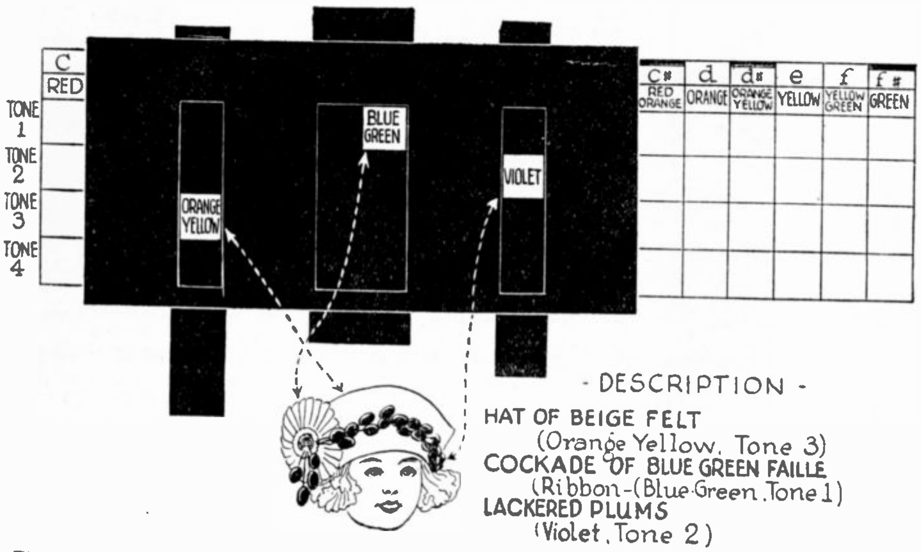
A new staff has recently been designed, upon which the music is printed in seven different sections. Each staff is identical and any point in one staff is equivalent to a corresponding octave in the other staff, so that only one group must really

(*Continued on page 999*)

The Latest in Color Harmony

By WILLIAM R. REINICKE

IN recent years and especially since the Great War, there has been a great demand for better design and color combinations. Color is of primary importance and is unquestionably the most difficult branch of the training. Either the student is endowed with a strong untutored color sense or none at all. The placing of the Taylor system of color harmony in the hands of the



The color chart shown in use above, with an adjustable three slide mask enables anyone to select harmonizing colors of different tones, and it has proven of unquestionable worth to milliners and dressmakers. It is also of great value to artists, sign painters, editors, and in fact anyone who has to do with the selection and matching of colors. The chart is here shown in use for the selection of colors to be used on a lady's hat.

greatest selling factor entering into the manufacture of numbers of commodities placed on the market today. In the designing of textiles, woman's apparel, and all the objects of general utility and decoration for the interior of the home today, color is a paramount issue. Often it is merely the touch of ingenuity in the handling of color, the last indication of dexterity, which weighs in the invisible scales between success and failure.

Many hundreds of thousand of dollars are wasted each year in this costly experimentation. Consequently any new adventure, which can reduce the tremendous waste, will be readily welcomed by all progressive manufacturers. When in addition it supplies the designer with a real creative inspiration and helps him to an intelligent mastery of color the significance of this new impetus to the American manufacturer can be appreciated.

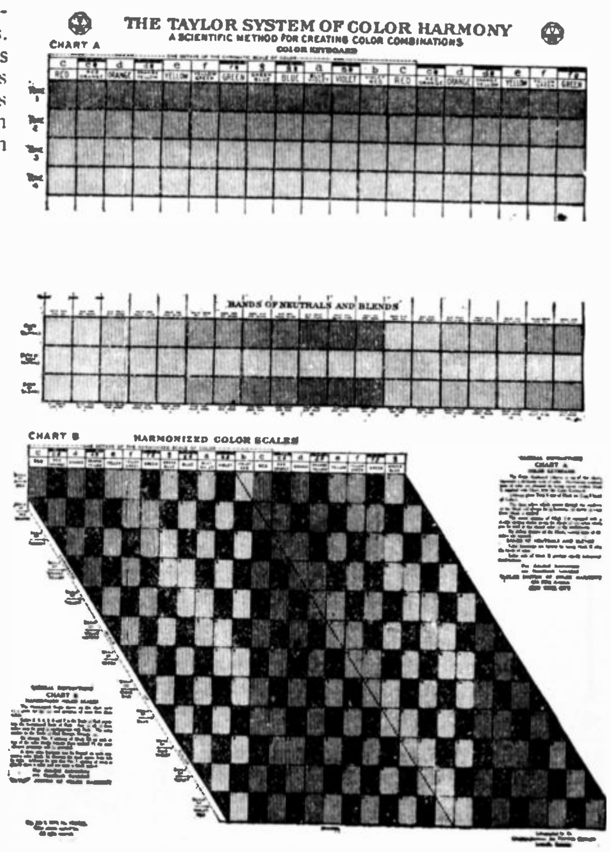
Lithography and color printing offer a larger opportunity than any other field for the progressive and creative use of color. From the large lithographed poster to the simplest printing job which comes to his plant, the lithographer, in the majority of cases has the power of color initiative and ultimatum, and it is the use or abuse of this power, which will be largely responsible for the next chapter in the history of commercial lithography.

The significance of color in modern advertising cannot be overestimated. It has practically come to be indispensable to the successful exploitation of a great number of commodities. Data compiled from the responses to colored and uncolored illustrations in the mail order catalogue put this significance and importance of color beyond the pale of guess or experiment.

There is hardly any line of manufacturing where color is not used to some extent. In the teaching of art, color is generally conceded to be the student (and designer enables him to find himself, and to build up a discriminating use of color and a sound foundation.

For a long time it was generally believed that a color sense was a gift, with which one was born, and which could not be cultivated. To a certain extent this is true, as some people are endowed with a more subtle and pronounced feeling for color than others, but, after all, color must be controlled by certain fixed and definite laws. The discoverer of the laws underlying color harmony was Henry Fitch Taylor, who has created a simple chart form of color harmony. Through the opening of masks laid over carefully graded bands of spectrum color, an indefinite number of fresh, distinctive and harmonious combinations of two, three, four, five, six or more colors can be made to appear instantaneously before the eye.

It has been estimated that some 20,000 color combinations made up of full color, tints, neutrals and blends can be formed by the use of this color scheme.



Above is shown a black diagram of the color harmony chart greatly reduced in size.

These charts are lithographed in seventeen impressions and actually show ninety-six different colors exclusive of black.

Harmonious color combinations are produced by viewing different combinations of color through openings in black cardboard masks, three of which are furnished with each chart for different uses.

One of the problems most frequently encountered is the selection of one or more colors to be used with a foundation or background of a particular color. The desired color may be the color on which a printing job is to be executed; the color of the material out of which a hat or gown is to be made; or, perhaps, the color of the walls of a room for which harmonious furnishings are required.

The first step in the matching of colors is to locate upon the color keyboard or on blends of neutrals and blends, the color most nearly approximating the one you wish to match. You must bear in mind that, while there are many thousands of colors in common usage today, the basis of every one of them can be referred to one of the colors of the spectrum. Consequently while you may not be able to locate the identical color you are seeking, you can locate its basis or affinity in one of the colors of the keyboard.

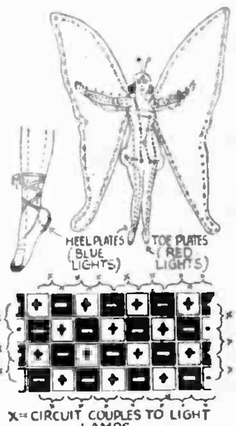
For example, suppose that the color chosen is green. If it does not incline toward the yellow or the blue it will have a basis in green of the color keyboard. If it inclines toward yellow, its basis will be yellow-green of the keyboard; if it inclines towards blue, its basis will be green-blue of the keyboard. Again many colors are so neutralized and blended with others as to make their basis not easily determined. The bands of neutrals and blends should be consulted here for matching.

When you have located on the keyboard, or hands of neutrals and blends, the desired color or its nearest relation, you place No. 1 opening of mask 1 or 2 upon that color. Let us suppose, for

(*Continued on page* 1007)

Dancer's Toes Light Costume

One of the accompanying illustrations shows how a little German ballet dancer lights her costume in several different colors, by means of metal contacts on the toes and heels of her dancing slippers. This dancer is little Editha Ott, ten years old, born in Berlin. She is billed as the original electric ballet dancer, and she does toe and fancy dances on an electrical carpet, made after the fashion here shown, with alternate positive and negative contact plates sewed on it. As soon as she steps on the electric plates on the carpet, that is plates of opposite polarity, the costume lights up, giving a very wonderful fairylike effect. When both heel and toe plates are allowed to make contact with oppositely charged copper electrodes, both circuits of colored lights are illuminated; when she stands on her toes, the circuit connected to her heel plates is extinguished, and if only the heel plates are left in contact with the copper electrodes, the lamp circuit connected with the toe plates is darkened. This clever electric costume and carpet were invented by her father, who is an electrician.



Miss Editha Ott has made a great hit on the German stage, especially it is said in her interpretations of Rubinstein's *Valse Caprice*, Powell's *Comic Dance*, and the *Little Fly Shimmy*.

The bulbs on this dancer's costume are supplied with current from the checker board floor through toe and heel plates secured to the bottom of the dancer's feet. Two independent circuits connected to the plates operate either the red or blue lights.

Great Movie Scene in Small Space

By Dr. Albert Neuburger

IN Germany new methods of manipulation have been found which will lead to the production of more versatile films, at a cheaper price than hitherto has been obtained. Though there are, in California, in the film cities, reproductions of buildings of all styles of architecture, so that the world is represented in its scenery, in Germany the film *Demetrius* was produced, which involved the representation of the Kremlin, with the "Red Square" in front of it, in the city of Moscow. It was proposed to go to Moscow to take the views, but the Soviet Government laid down conditions which were impossible of fulfillment, so there was nothing left to do but to reproduce the Kremlin, together with the "Red Square" in front of it.

By a system of progressively diminishing the size of the scenery, it was possible to photograph the scene at the left within an area of 150 feet. In this way lighting the scenery is greatly facilitated, yet the depth of the picture is maintained.

It would have been quite possible to reproduce the plaza in its real dimensions from the airship-hall of Staaken. This is nearly 1,000 feet long and 150 feet high. The trouble is, of course, to obtain sufficient light for so great an area. A moving picture expert, Walter Reimann, found a way to reach the goal. He erected the foreground of the square in its natural dimensions, using everyday scenery, and then by a system of perspective, diminishing the sections of the scenery as he went back, reproduced what appeared to be the entire length of the square within 150 feet. The effect was striking and astonishing. It looked as if it was 1,000 feet long. Some parts of the side wall in front are of the true height of about 35 feet, but as one gets to the rear, the wall shrinks until it is but little over 12 feet in height, thus giving the artificial perspective, all based on exact mathematical calculations.

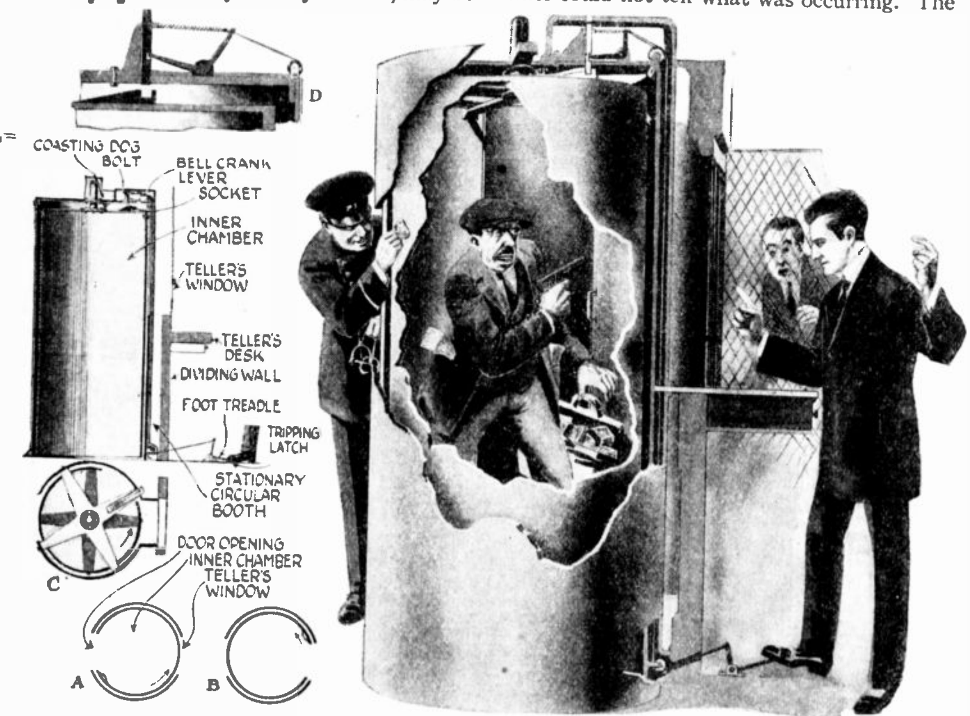
To avoid the erection of a model of the Cathedral, it was painted on a sheet over 150 feet high and about 80 feet in width, in exact perspective. The building in the film appeared in perfect relief, as if it were really photographed.

Special methods were adopted for tightening the canvas, and it is considered that the whole thing was done at about one-tenth of the expense anticipated. A forest was erected on a circular stage. To get the different views, the stage was not rotated, but the moving picture camera was carried about it so as to give the correct background.

Thief-Trapping Booth for Banks

HOW would you like to have absolute privacy when entering a bank to deposit or withdraw your money from its vaults? A very good idea, is it not? Yet such a thing is not only fully possible, but, as recently patented by Emery E. Dell, may be placed in the larger banks in this country.

In front of the teller's or cashier's window is a round, domelike structure. The patron enters through a door, and a sign within this circular structure notifies him to turn a handle. In doing so, he rotates a drum which seals up his exit completely, and opens a door communicating with the teller's window. If the patron should happen to be a woman, she could now stoop down, lift up her dress, and remove her valuables from her stocking, sometimes erroneously called, "The First National Bank." Outside observers cannot see what she is doing, because the door through which she entered is now sealed. She may be depositing an immense amount of specie or bills, or she may find it necessary to withdraw a similar amount, yet the yeggmen or snatch thief could not tell what was occurring. The transaction is absolutely secret, in other words. Having completed her business dealings, she again grasps the handle and leaves.



New thief-trapping steel booth for banks. If the person within the booth suddenly whips out a gun and demands the money on the cashier's desk—he gets the money all right, but when he goes to turn the inner cage, the cashier "gets him," for his foot trips the lever system which causes a lock bar on top of the cage to drop into place, the inner steel shell then being locked in a closed position, trapping the robber. He can be released when the police arrive.

Should, however, a thief enter the teller's cage with a view of threatening the life of the teller, for the purpose of robbing the bank, it is merely necessary for the teller to release his foot from the tripping latch on the floor, and the thief is trapped in a steel prison. The opening leading to the teller's window, being naturally rather small, will not permit him to pass out of the booth in that direction, and he can under no circumstances rotate the inner shell of the trapping device.

Essentially the installation comprises a large circular drum, having an entrance at one end and a small window opposite communicating with the teller's desk. Due to a second concentric drum, also provided with an opening which acts as a door, and which is free to turn, the teller's window is obscured from view until the patron of the bank enters the double steel shell. Having entered this and grasping the handle and turning the same through 180 degrees, he brings the door-opening in line with the teller's window opening in the outer shell, and then transacts his business. On top of the rotating or inner shell is a rack bar, and descending from the stationary shell is a small pawl. This rack and pawl permit the inner casing to turn in one direction only. In addition to the rack there is a pin which slides up and down, and which is held in the down position by means of a spring and a bell crank lever. This bell crank lever is connected with a trip located within the teller's cage, by means of a cord passing over a series of pulleys. The teller keeps his foot upon this trip at all times. When, however, his life is threatened, he merely stands up and walks away, or ducks behind his desk and the window. In doing so his foot is automatically released from the lever, which permits the pin in the top of the stationary cage to fall downward. The thief may then remove whatever valuables he desires. He may even start a western gun fight. There is nothing to stop him, but when he attempts to leave the bank, even after having shot up the place, the pin in the top which has, as heretofore stated, been released, is raised on a track provided for that purpose on the revolving cage. When it reaches its highest point, it drops into a slot, thus locking the cage in such a manner that the culprit can no longer do any damage. The thief remains therein until the proper authorities have been called to lead him away.

Too bad that the inventor did not devise in addition to this system a method of rotating the inner cage at will without waiting for the individual therein to rotate the same. If then a person on evil bent, leveled his gun at the cashier, it would be a simple matter for him to release the trip, which would whirl the cage around with lightning rapidity, locking the transgressor within it before he could even make use of his gun. This could be simply arranged.

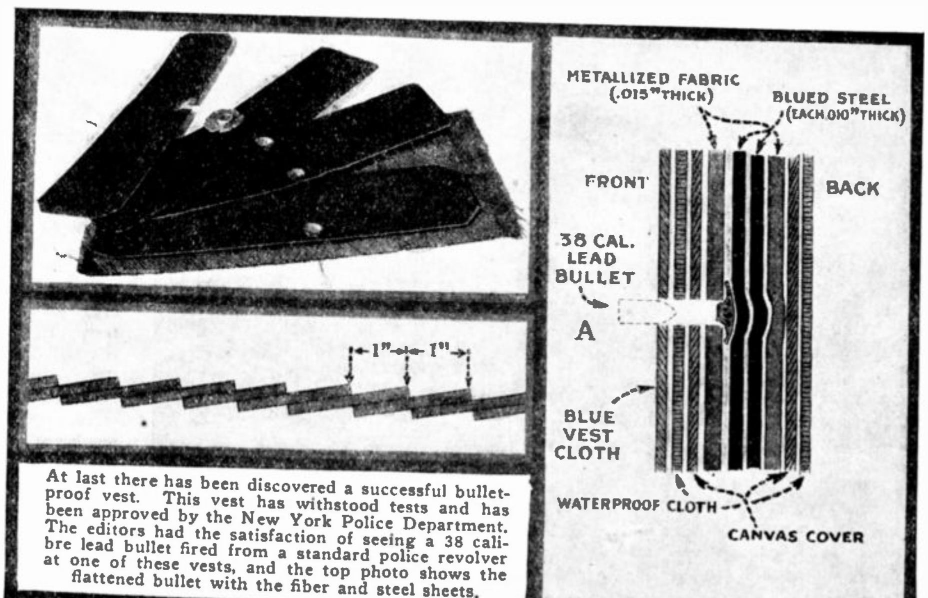
A New Bullet-Proof Vest

TIME and again there have been on the market various types of so-called bullet-proof vests, but up to the present time each one has been found defective in some way or other. In some of them there were sharp corners and edges which gave the wearer unpleasant cuts and bruises when the vest was struck by a bullet, and others did not even stop the bullet.

However, a New York concern is at present manufacturing a vest which is guaranteed against all revolver bullets whether lead or steel jacketed, and furthermore, the bullets when striking the vest, cannot ricochet or glance off, thereby hurting anyone in the vicinity.

The principle of the armor contained in the vest is that of overlapping steel strips. These strips are about six inches long and two inches wide, and are made of clock-spring steel. Two strips are laid together, and on each side of them is placed a strip of metallized fabric. This fabric is one of the important parts of the vest, as it obviates any possible chance of the bullet glancing off. The exact composition of this metallized fabric is a secret. The reason that the bullet cannot

(*Continued on page* 1031)



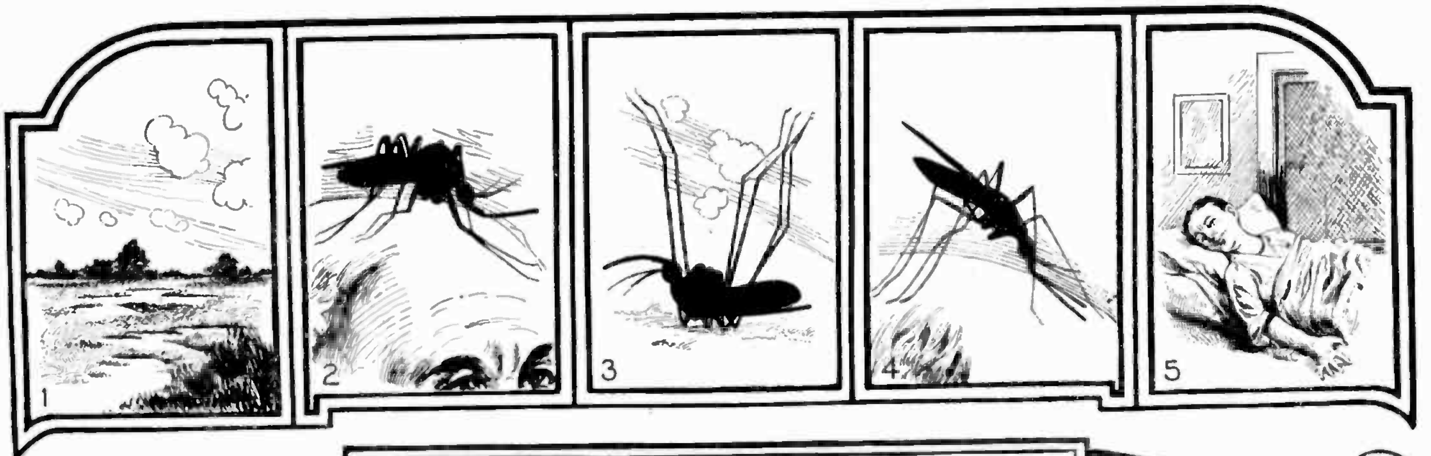
At last there has been discovered a successful bullet-proof vest. This vest has withstood tests and has been approved by the New York Police Department. The editors had the satisfaction of seeing a 38 calibre lead bullet fired from a standard police revolver at one of these vests, and the top photo shows the flattened bullet with the fiber and steel sheets.

How Mosquitoes Spread Malaria

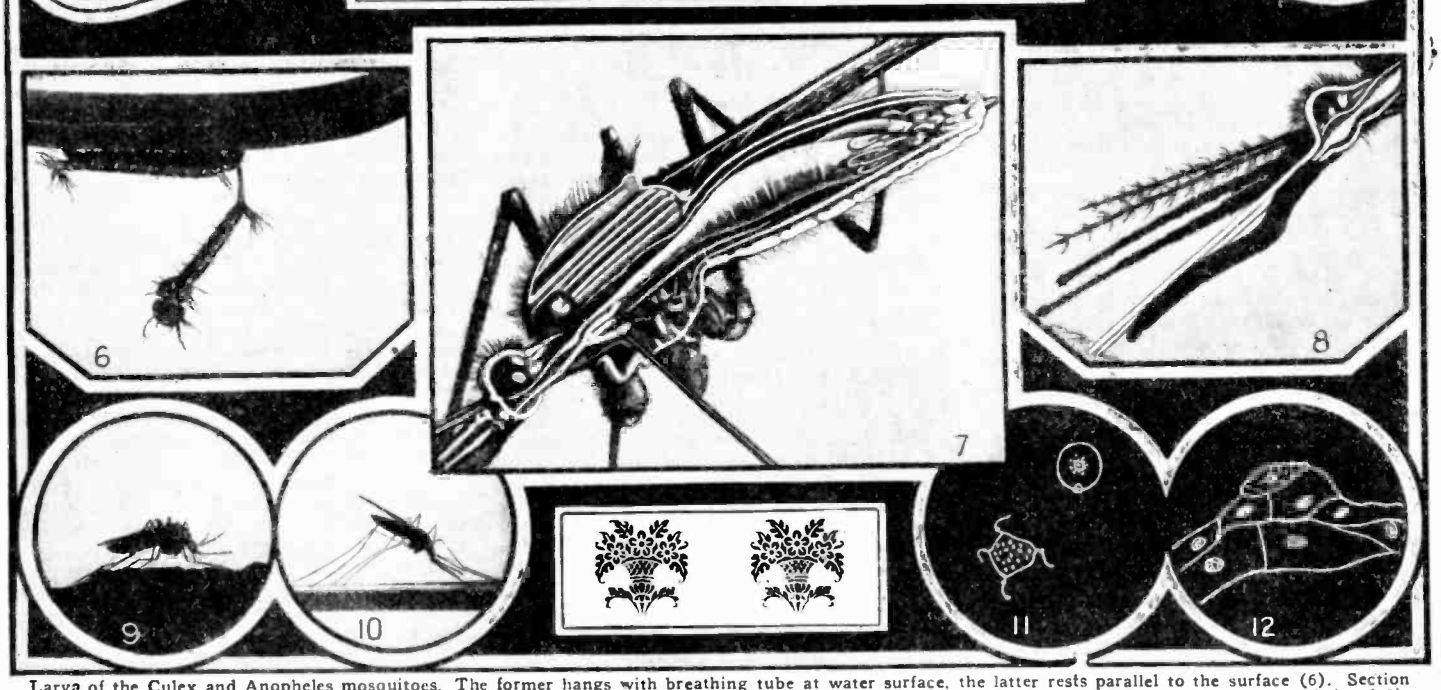
By CHARLES FREDERICK CARTER

MALARIA causes an economic loss of one hundred million dollars a year in the United States alone, not to mention unparliamentary language beyond computation, untold wretchedness and even death. This vast loss is unnecessary, the suffering is pared by the Bray Productions, Inc., under the direction of the Surgeon General, United States Public Health Service a series of films on the "Science of Life." One film is devoted to the malaria carrying mosquito. Any one who, after seeing this truly remarkable picture, deliberately neglects any pre-tifically accurate, are shown of the *female anopheles* sucking blood from a malaria patient containing germs of the disease. The mosquito's blood pump is shown at work while the stomach gradually distends.

The malaria parasite undergoes two distinct cycles of life. One begins promptly



Marshes breed mosquitoes (1). The adult alighting on person infected with malaria sucks malarial parasites into her body. (2). Mosquito herself dies of disease (3), but often infects others before dying (4). Result—victim of malaria (5).



Larva of the Culex and Anopheles mosquitoes. The former hangs with breathing tube at water surface, the latter rests parallel to the surface (6). Section through adult mosquito (7). Pumping apparatus of adult (8). Horizontal feeding position of Culex mosquito (9). Feeding position of Anopheles (10). Male cell of malarial parasite below and female cell above (11). Section through wall of mosquito stomach with poroblast forming on inner wall (12).

needless, the deaths unpardonable; for all is due to an unholy alliance between malaria victims and mosquitoes. At least, if it isn't an alliance it certainly is cooperation of the closest sort. Without mosquitoes the disease could not be carried to healthy persons; without at least one malaria victim to supply germs the mosquito would be helpless.

All this has been told in print many times, but the lesson has not been heeded. The economic loss of one hundred million dollars a year continues, the "fever'n'ager" shakes health and the joy of life out of its victims; the angel of death, already overworked dancing attendance on reckless automobile drivers, has to garner an extra harvest.

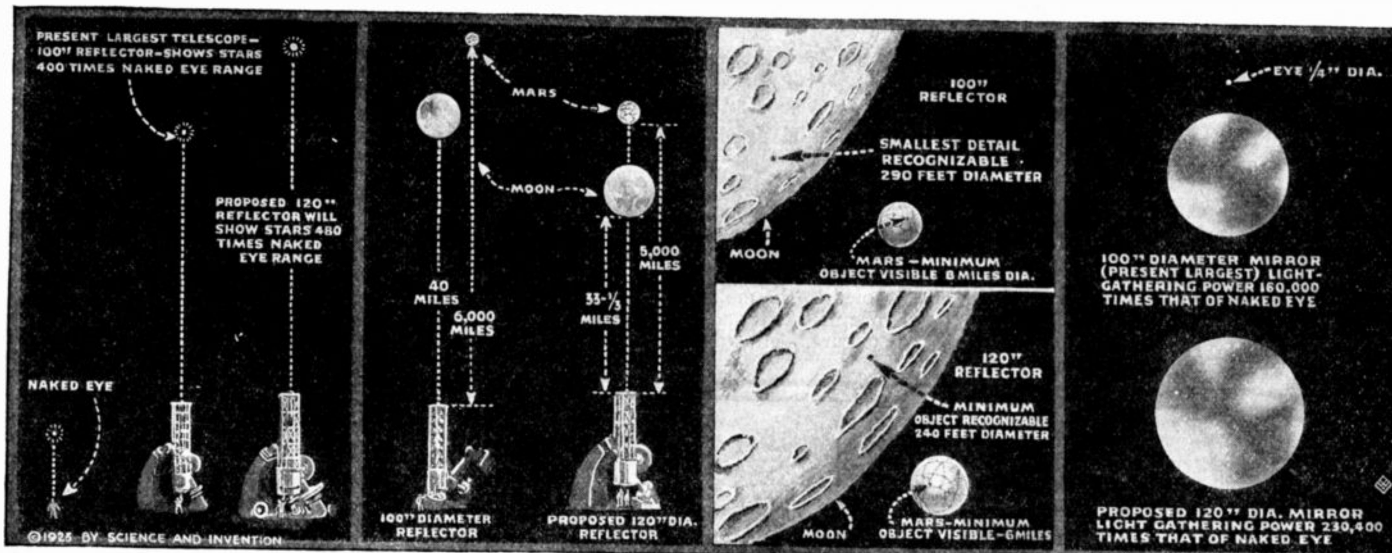
As a more effective method of getting the message to the millions there has been pre-caution to protect himself from malaria deserves to have the disease. The Government is not organized or provided with funds for general distribution of these films, which are strongly recommended by the Surgeon General who directed their production, so that part is left for Bray Productions.

Reel VIII, "How the Mosquito Spreads Disease," begins at the egg with a biography of the *anopheles*, the genus which carries malaria germs. How to distinguish between the culex, the harmless mosquito and anopheles is shown. Even the male anopheles is a respectable insect, living on an exclusive diet of plant juices and keeping regular hours. But his depraved wife feeds on blood whenever she gets a chance.

Some marvelous animated drawings, scien-when the cell enters the body of the mosquito. Step by step, the bacilli are seen in the digestive tract developing and then separating into male and female cells. Follows next the union of the male and female cells to produce a new cell, called "zygote," which is the first stage in the life of a new generation of the parasite. This new cell passes through the mosquito's stomach wall and begins to divide, producing more and more, until there is a mass of free swimming cells called "sporozoites," so large that it finally bursts and spreads into the body cavity. Each step is shown on the screen.

Next the sporozoites collect in the mosquito's salivary gland where they lie in wait for a chance to dart into the body of a human being, there to begin their second

(*Continued on page* 998)



In the above illustration, we find graphically represented the difference between the largest telescope now in use, and the proposed reflector. The relative size of the Moon and Mars, as they now appear on the largest telescope and as they will appear when the new telescope is completed, are depicted above, as are other interesting facts concerning this new reflector.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory, Washington, D. C.

What We May Expect of a One Hundred Twenty Inch Reflector

THE city of Seattle, Washington, it is reported, is to have in the near future a one hundred and twenty-inch reflector. Details of the manufacture and finishing of the mirror and of the style of mounting that will be adopted have not been made known up to the present time. It is possible, though, to judge what might be expected, theoretically, of an instrument of this size. Whether the telescope now under construction will measure up to the theoretical requirements will depend upon the quality of the glass of which the great mirror is made, the care taken in figuring and polishing it, the manner in which it is mounted and adjusted and last, but not least, the atmospheric conditions under which it will be used.

Tests of the 100-inch Hooker telescope of the Mt. Wilson Observatory, now the largest in the world, have demonstrated the fact that it fully fulfils the theoretical requirements of an instrument of its size.

The light-gathering power of a telescope is directly proportional to the square of its diameter,—or aperture, as the astronomer calls it,—or to its area. The area of a 120-inch telescope is 1.44 times the area of a 100-inch telescope. It should, therefore, gather 1.44 times as much light as does a 100-inch telescope and show stars that have only 70 per cent of the brightness of the faintest stars visible with the 100-inch telescope.

One advantage of this increase in light-gathering power is that it brings into view millions of stars too faint to be seen in other telescopes and greatly extends our vision of the universe of the stars. It permits us to explore further into the outer areas of space.

The penetrating power of the human eye or of a telescope (that is, its ability to penetrate into space), is proportional to the square root of its light-gathering power or to its diameter. The diameter of the human eye is on the average about one-quarter of an inch. The diameter of a one-inch telescope is four times, and its light-gathering power is sixteen times, that of the eye. The diameter of a 100-inch telescope is 400 times, and its light-gathering power is four hundred squared or 160,000 times, that of the eye. The diameter of a 120-inch telescope is 480 times, and its light-gathering power 230,400 times, that of the eye. A one-inch telescope, then, can penetrate four times further into space than the human eye and the 100-inch telescope will penetrate 400 times further than the human eye and the 120-inch telescope 480 times further if perfect.

Consider, for example, the sun or any dwarf star of equal luminosity. At a distance of 33 light years—standard astronomical distance for comparing the *actual* or *intrinsic* brightness of stars as distinguished from *apparent* brightness—the sun or any star of equal brightness would look like a fifth magnitude star just comfortably within the limits of visibility. At a distance of 52 light years it could just barely be glimpsed as a sixth magnitude star at the limit of visibility of the human eye. If we used a 100-inch telescope, however, it could be glimpsed if it were 400 times more distant or at a distance of 20,800 light years, or with a 120-inch telescope at a distance of 24,960 light years. All dwarf stars equal in brightness to the sun could be picked up then by a 120-inch telescope any where within a zone 4,160 light years deep lying beyond the point at which they could just barely be glimpsed by the 100-inch telescope.

In other words, our own sun would be visible in the 120-inch telescope, if it were 4,000 light years beyond the point at which it would sink out of view in the 100-inch telescope.

Consider now a star 100 times brighter than the sun. There are many such stars in the universe. Compared to the sun, they are giants. At a distance of 33 light years—standard distance—they would compare with the sun as a fifth magnitude star compares with a star such as Vega or Arcturus or Capella, stars brighter than first magnitude stars. For the naked eye, the limit of visibility of a star 100 times brighter than the sun is 520 light years, for the 100-inch telescope 208,000 light years, for the 120-inch 249,600 light years. We have then a gain of 41,600 light years for the 120-inch telescope in the case of stars 100 times brighter than the sun. It will be noted that a star 100 times brighter than the sun can be seen 10 times further away than a star equal to the sun in brightness, the limiting distance at which any star can be seen being proportional to the square root of its luminosity.

Considering now the super-giants of the universe, that are 10,000 times brighter than the sun, we find that at standard distance of 33 light years, at which the sun resembles a fifth magnitude star, such stars as these would outrival Venus in brightness. The square root of the luminosity of such stars compared to that of the sun being 100, they would be seen 100 times further away than a dwarf star such as the sun. With the unaided eye they could be barely glimpsed as sixth magnitude stars at a distance of 5,200 light years. With the 100-inch telescope they could be seen at a distance of 2,080,000 light years and with the 120-inch telescope at a distance of 2,496,000 light years. In observing super-giants of the universe 10,000 thousand times brighter than the sun, we find that the 120-inch telescope extends our vision 486,000 light years.

It is evident, then, from the above considerations that a 120-inch telescope would enlarge our vision of the universe and bring into view countless stars that cannot be seen even with the 100-inch reflector.

So far we have considered only individual stars. There exist, however, in addition to the isolated stars, clusters and groups of stars at enormous distances from the earth and conglomerations of stars and nebulous matter believed by some to be island universes. Each of these distant groups of stars gives forth as much light as millions of stars of the luminosity of our own dwarf sun. The combined light of these stars in clusters or nebulae would be visible as faint hazy patches of light in powerful telescopes at distances of millions of light years. The range of visibility of the 120-inch telescope for these faint groups would far exceed that of the 100-inch. A cluster giving only 70 per cent of the light of the faintest cluster visible in the 100-inch could just be glimpsed with the 120-inch telescope at a distance one-fifth greater. This, of course, holds also for individual stars.

Coming now to our solar system, let us

(Continued on page 996)

Scientific Problems and Puzzles

By ERNEST K. CHAPIN

NO. 5 OF A SERIES

WEIGHING THE ELEPHANT

IT is related as a historical fact that many years ago the settlement of a political issue between two Chinese states depended upon the solution of the following scientific problem which the representatives of one state presented to their opponents.

"Determine for us the weight of this huge elephant," they requested, pointing to one of the animals nearby, "that we may have evidence of your intelligence and fitness to deal with this matter in your own way."

To-day the problem would be simple indeed; but in the absence of all modern apparatus, how could it have been done then without sacrificing the elephant?

WEIGHING THE FISH

"Tut, tut, boys, no squabblin'," said an old fisherman as he came upon a pair of boys in hot dispute.

"But Jake says this fish that he caught is a five-pounder, and I know darn well it don't weigh nowhere near that much," rejoined one of the lads somewhat ungrammatically.

"Well then, my hearties, why not weigh the fish and end the argument?"

"Shucks, how're you going to weigh a fish without scales?" retorted the boy. "And you needn't spring that one about using those on the fish," he added quickly, "'cause that's old."

"Well, well," laughed the man, "that just goes to show how helpless we are when deprived of our modern methods and conveniences. Here you have a measuring tape, a jack-knife, and a bamboo pole the weight of which you know, I dare say, to a fraction of an ounce—in short, everything you need to determine the weight of the fish—but instead of going about it in the obvious way, you sit here and fight over the question." And without further words he showed the boys how to weigh their fish with just the simple apparatus which they possessed. Could you do it?

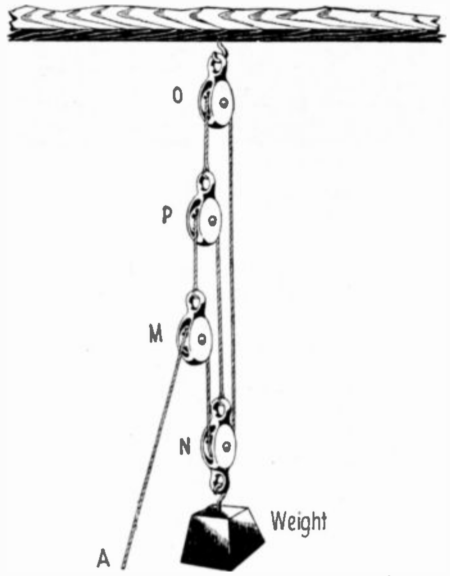


Diagram to accompany "Problem of the Hoist." Fig. 1

REVERSED ROTATION IN MOTION PICTURES

It not infrequently happens that in a motion picture of an automobile or other vehicle the wheels appear to go backwards or even stop while the car is still progressing forward. What explanation can you offer for this?

THE FREEZING WATER PIPES

It has often been observed that on a cold night the hot-water pipes are more apt to freeze than the others. Another curious fact is that a pan of hot water will often freeze before a pan of cold water, although both have been exposed to the atmosphere for the same length of time. Can you account for this satisfactorily?

THAT RATTLING GOOD CAR

"No sense in wasting money on a speedometer that doesn't work half the time," observed Gassoway Miles proudly as he listened to the hood rattling like a pneumatic riveter. "This car has a different rattle for every speed, and I know 'em all."

Only too true, Gassoway, but why is it?

MELTING SNOW IN COUNTRY AND TOWN

Have you ever noticed how much more rapidly snow melts in cities and towns than it does in the open country? What good reason can you give for this fact?

THE PROBLEM OF THE HOIST AGAIN

In the September number of SCIENCE AND INVENTION there appeared in the series of puzzles one involving the relation between the weight and effort in a pulley system. As the author by mistake submitted a sketch for a different pulley system than was intended, the answer published was quite incorrect. Fig. 1 illustrates the system which should have appeared at that time. If you do not recall the answer given for this puzzle in the September issue, can you now determine what weight would be balanced by a force of 100 lbs. applied downward on the rope *A*? (*Continued on page* 1000)

Midget Telephone Apparatus

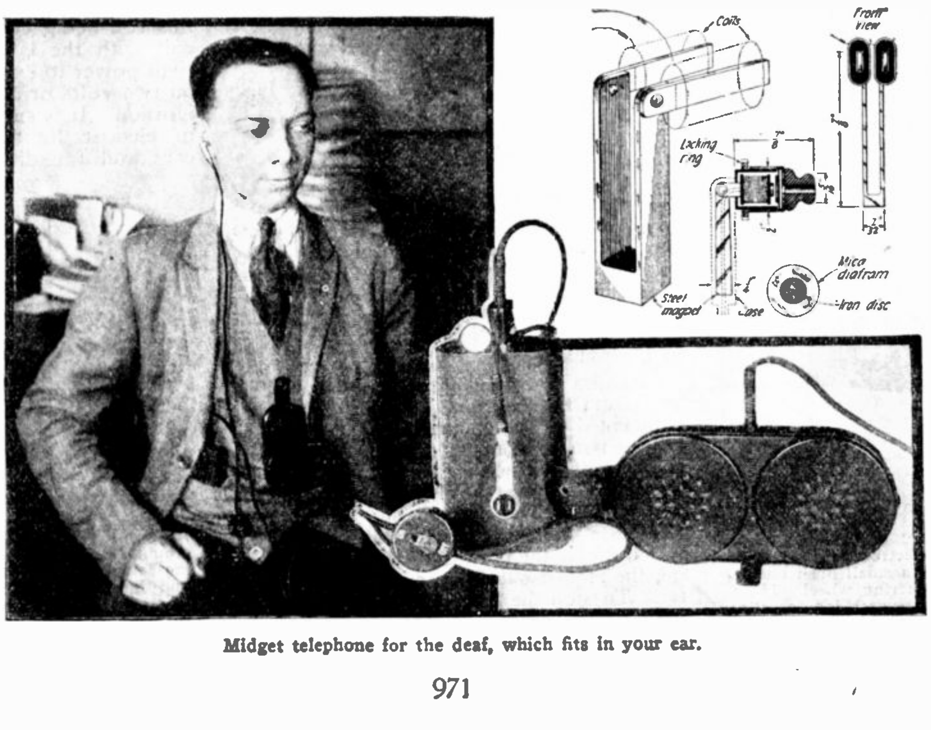
Various electrically governed appliances designed to assist deaf persons have been placed on the market during the last few years. All of these, with one exception, were equipped with a telephone-like receiver so constructed as to be held to the ear by hand, or by means of a metal head-band.

The very latest invention in this line is an invention by the German scientist, Louis Weber. This instrument is now being imported to this country and extensively used by the deaf. The receiver or ear-piece is reputed to be the smallest (yet at the same time very efficient) receiving device ever invented. The instrument consists of three parts, the transmitter, receiver and a small dry-cell battery. The transmitter is a flat appliance measuring about 2 x 4½ x ¼ inches; its weight is about 4 ounces. The battery resembles all other batteries used for the same purpose, but the receiver is distinctly different from all other receivers so designed for that purpose. It is an L-shaped appliance measuring little over one inch each way and is so constructed that it can be worn comfortably in the outer ear-passage. Its exact weight is one-half of an ounce. Though it is so small it is of perfect construction and embodies all the parts which a sensitive receiver should possess.

Instead of the large metal diaphragm used in the former hearing devices, the midget receiver contains a tiny drum of especially produced membrane—almost a perfect duplicate of the human hearing drum. This important feature disposes of the extraneous noises as well as of the metallic sounds, and carries to the ear the true tonal value of every sound received.

The principle of this ear-phone is electromagnetic, as employed in the ordinary telephone receivers. Since this device is worn in the outer ear passage, all sound entering the ear passes through the instrument. The amplification afforded to the deaf is of such volume that they can invariably hear distinctly when wearing this instrument. By virtue of construction it is practically unnoticeable when adjusted to one's person.

So far as we know this represents the smallest electromagnetic telephone receiver made.



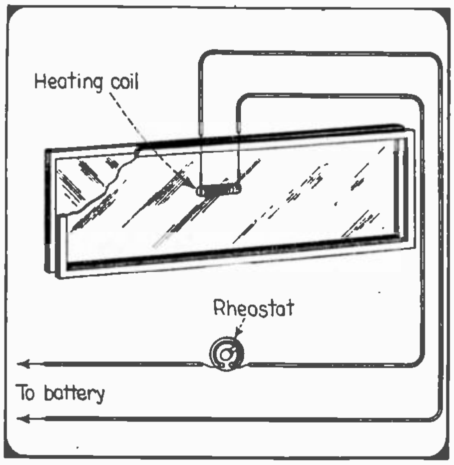
Midget telephone for the deaf, which fits in your ear.

MOTOR HINTS

First Prize, $25.00

MOISTURE-PROOF WINDSHIELD

Some time ago I sent you a diagram of my moisture-proof windshield and asked that it be entered in your motor hint contest.



This moisture-proof wind shield for motor cars comprises a warm air chamber between two glass plates, which is kept above the freezing point by an electrically heated coil. This coil is heated by current from the storage battery, and by using a rheostat and small thermometer placed inside the glass chamber, the temperature can be maintained at any degree desired.

Since that time I have decided to send you a model of the attachment which would more clearly convey to you its simplicity and usefulness.

The attachment, as shown by model, has a hot air space which is kept above the freezing point by a coil that is heated from the storage battery. By using a rheostat on the dash, the current can be regulated to any desired temperature.

I am using one on my car, and it can be operated successfully on three or four amperes of current, or less.

I sincerely hope that this attachment will not prove to be only an electric novelty, but a valuable asset to the motorist who is handicapped in the winter by having a windshield covered with ice, thereby obstructing, if not totally obliterating his view of the road; consequently, reducing the number of automobile accidents, loss of life and property.

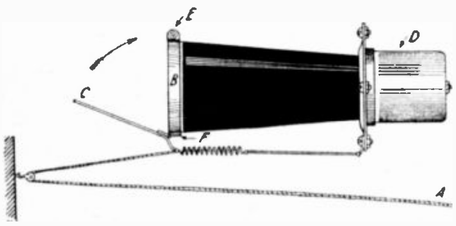
Contributed by E. T. Sonendriker, M.D.

Second Prize, $15.00

TWO-TONE ELECTRIC HORN

Herewith is a sketch of a *tone changer* for a motor-driven horn. It is just a simple door placed over the mouth of the horn, with a spring to hold it open when not in use.

Support B is a strip of tin ¾ inch wide, with four projections ½ inch long, to be bent over the edge of the horn to prevent it slipping back. It has a small brass hinge F



This two-tone electric horn is very simple to rig up and can be arranged to be manipulated either manually with a cord or wire, or better still, by using a solenoid electro-magnet, operating the latter by means of a small push button, placed preferably on the steering wheel. If desired, the electric button or switch for operating the tone-changing shutter may be placed on the floor, so as to be operated by the foot.

NOTICE TO CONTRIBUTORS

KINDLY note a change in this contest. For the coming months we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term PRACTICAL will be the key-note of this contest.

You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles which win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.

soldered to it on one side and a bolt E through the ends to clamp it on with.

Strip C is then soldered on the hinge, with a hole in the end for the spring and control wire. Then a round cardboard disc, the size of the mouth of the horn, is bolted to C on the inside. The cardboard prevents noise when closing.

Cord A should be fastened so that it can be operated with one finger and the horn button with the other. A stop should be put on the cord where it passes through the dash to prevent it from being pulled too far.

To operate, press horn button for natural tone; for muffled tone pull A; for a shrill tone, release cord while horn is blowing.

If it still makes a coarse tone after the cord is released the adjustment screw D will need loosening a little, maybe not more than one-twenty-fifth of a turn. It shouldn't be so loose that it will make the shrill tone without first pulling the cord.

Almost any one likes a good horn and the change in tones will get attention in heavy traffic.

Contributed by Geo W. Salsman, Jr.

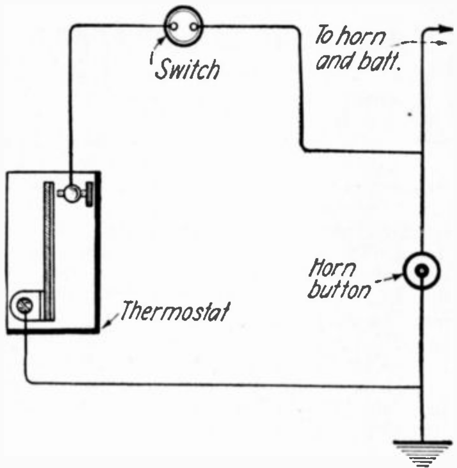
Third Prize, $10.00

LOW WATER ALARM

When the water in the radiator gets low the engine will begin to heat and every motorist knows that it does not pay to run the engine when it gets too hot. The arrangement shown in the accompanying diagram will warn the motorist when the water in the radiator gets low.

The idea is exceedingly simple as will be seen from the diagram. A small thermostat is mounted on the engine or radiator, and is adjusted so its contacts will close when the engine gets too hot. The contacts are then connected across the horn button. Now when the engine gets too hot the contacts will close, thereby shunting the horn button, which causes the horn to operate, thus warning the motorist that the radiator needs water. To stop the horn the switch is opened but this switch should be closed when the engine has cooled down, so the thermostat will again operate the horn when the engine gets too hot.

Contributed by Amedeo Giolitto.

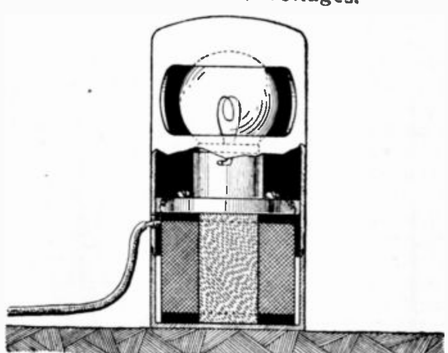


An effective low water alarm which requires no extra battery or elaborate attachments. All that is required is a sensitive thermostat, which may be home-made from a piece of thermostatic metal, and a switch to open the circuit. The thermostat may be very well placed inside the radiator cap and when properly adjusted, will prove an infallible detector of low water conditions.

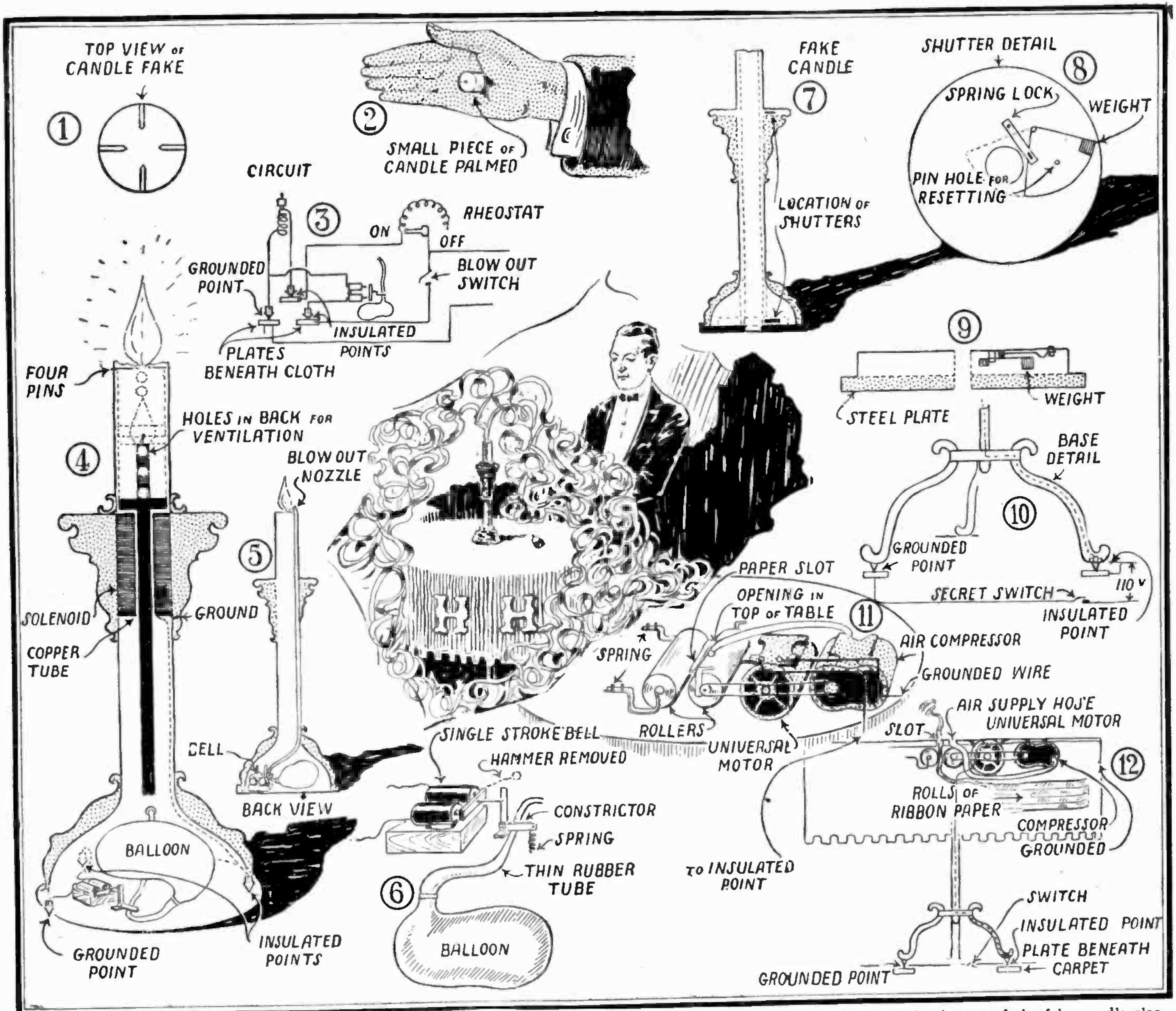
MAGNETIC AUTO TROUBLE LIGHT

This little magnetic trouble light is indispensable when night repair work is necessary. Tire changes and emergency repairs can be made without fumbling or groping. It directs a strong, steady, brilliant beam of light accurately on the job with no blinding back-glare to tire the eyes or impede the work. This sturdy little light has an electro-magnet base which holds it tenaciously to any iron or steel surface, curved or flat. On fenders, axle housing, or motor it clings tight and refuses to budge until the work is finished. A heavy nickel plated reflector directs the four candle-power light precisely where it is most needed and protects the eyes so the work may be done in comfort. It is attachable to dash or any other socket about the car, and 12 feet of cord permits reaching any part of the car. Simply push in the plug, stick the light against a metal surface, and there it stays in spite of jars and poundings.

The magnetic trouble light is fitted with a small magnet coil as illustration shows, this coil being connected in the same circuit with the lamp, and producing sufficient power to exert a pull of three pounds on two volts or a potential insufficient for ignition. It is supplied for different types of electric lighting systems on various cars and for different voltages.



A simple and efficient design of magnetic trouble light. The electro-magnet as well as the lamp is operated from the storage battery, and but one flexible lead 12 feet long, leads from the trouble lamp to any convenient lamp socket. The end of the cord is fitted with an attachment plug, which fits in automobile lamp sockets.



The mysterious candles described in the accompanying article are shown in the detail above. At 1, the four pins in the top of the fake candle also illustrated at 4, are seen. These pins prevent the lit candle concealed within the fake (4), from projecting too far when current to the solenoid is turned on. Note the balloon in the base of the candle-stick, which blows out the light on command. The arrangement of the blow-out pipe is seen at 5; 3 is a circuit diagram, and at 6 we find the construction of the blow-out valve. In the paper-presentation candle, 8 and 9 demonstrate the shutter arrangement for disguising the hollow candle-stick, and 11 and 12 the perspective and side elevation of the table. When the candle-stick is placed on the table, the opening in the base covers both the slot for the delivery of pa per, and the air supply opening.

The Amateur Magician

By JOSEPH H. KRAUS

THE snow lay in drifts and, here and there, where the wind had blown it from the paved walks, blotches of ice, rough but slippery, lay before me as I wound my way to Hargrave's home. Upon entering into the library, it was some time before I was warm enough to talk coherently. Henry Hargrave, the master magician, with a cheery, "Hello, rather cold out this morning. Won't you have a chair," proceeded to demonstrate and explain two of his new novelties, which, in order to cover them fully in this article, will have to have most of the accompanying patter omitted.

Securing a candle-stick from the mantel over the open hearth fireplace and placing a lit candle in it, Hargrave blew out the light. Then walking toward where I was sitting, he proffered a box of Perfectos. Lighting mine and then his, he directed my attention to the candle-stick on the table by saying, "I guess we will have a little more light here." Tossing the lit match toward the table upon which the candle rested, I was astonished to see it light up slowly. In a moment I was upon my feet making toward the candle-stick, but was interrupted by Hargrave's, "Not so fast, Old Man. See if you can blow it out from where you are." I blew, but the flame did not even flicker. I was fully twenty-two feet away from it. I tried it again with the same result.

"Don't blow so hard," was his exclamation.

"Well, let's see you do it," I challenged. Puckering his lips, he blew a scarcely perceptible amount of air in the direction of the lit candle. It wavered, flickered, and almost went out. "See that," he exclaimed, "Now you try it." I did, but could not improve upon my previous attempts. He again told me to blow more easily, to which I exclaimed, "Why, it is against all the laws of physics . . . " "Now don't let us enter into any scientific discourses or explanations," he interrupted, "Just watch me. I blew too hard the last time, consequently the air passed the candle too swiftly, but if I blow very lightly—ever so lightly—we will see what we shall see."

He suited his action to his words and blew ever so lightly; in fact, I do not believe that a feather held three inches away from his lips would have quivered, because of the energy expended in that blow, yet the flame of the candle bent itself sharply and went out. "Well, I'll be—," "Now just a minute," he again interrupted. "I've got something else here that I want to show you. The explanations will follow."

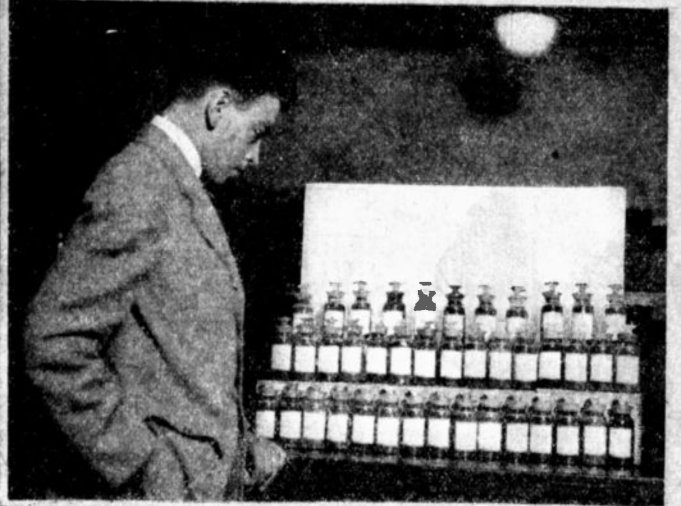
So saying, he removed another candle-stick from the mantel and placed it upon an adjoining table, such as magicians use. Breaking the top of it off, he drew out several hundred yards of paper ribbon. He then lifted the candle-stick, holding it at all times away from his body or the table, and placed it upon the table again, assuring me that he was at no time loading the candle-stick, which I was careful to observe he did not do. After he had thus replaced it he walked over toward me, saying as he

(Continued on page 1002)

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

DYES AND MORDANTS



In the photograph above we find an exhibit of forty-one different coal tar dyes.

A little heat and some congo red plus a mordant makes a very effective dye.

THE art of dyeing is ancient. It goes back to the earliest times. To beautify tapestries, rugs, and clothing with the varied colors of the rainbow in all their shades and hues has always appealed to the artistic sense of men everywhere. The wrappings of the Egyptian mummies are found dipped in that oldest of dyestuffs—indigo. The American Indian painted his body with colors indicative of peace or war. The varied and beautiful colorings of nature must have appealed very early to the artistic sense of primitive man. Gradually he learned the art of making dyes and applying them to the products of his hand and brain. But by what slow and tedious processes he came to a knowledge of mordants and the kinds of dyes best suited to different fabrics no record discloses. Certain it is that even at the very dawn of written history this was an ancient art.

Still up to 1856 the art of dyeing as it is practiced today was unknown. The great host of coal tar dyes was still to be discovered. In that year Sir William Perkin, then a lad of seventeen, by mere accident discovered the first coal tar dye. Working in his laboratory, much as many of you work and with even less chemical knowledge, young Perkin stumbled upon one of the greatest discoveries in the whole history of chemistry. He was endeavoring to isolate the drug quinine from coal tar. One night at the close of a discouraging day's work he mixed all the chemicals which he had been using together in a beaker and added alcohol. Immediately there flashed into view a beautiful purple color. Intoxicated with delight over this discovery the youthful chemist would not rest until he had isolated the dye and learned how to prepare it. His father built him a factory and in it began the wonderful story of coal tar colors and modern dyeing.

Classification of Dyes. Dyes are classified according to the materials for which they are best adapted and the chemical character of the dyes themselves. More than two thousand coal tar dyes are known to the trade representing every imaginable shade and hue.

Direct Dyes. A direct dye is one which may be applied to a fabric without the aid of any substance to hold the color fast to the fiber. These substances which fix the color are known as mordants. Until a few years ago, it was not supposed possible to dye cotton and linen without their aid. But now the production of direct dyes not only for vegetable fabrics but also in many instances for silk and wool are rapidly increasing.

The process of applying direct dyes is very simple. The dye is dissolved in a proper solvent, filtered through muslin to remove any solid particles, and is then added to a sufficient quantity of water to make the dye bath. The bath should be hot and the goods thoroughly wet before immersing. The bath should then be brought quickly to a boil and kept boiling until the proper shade is obtained. Upon removal from the bath rinse the goods thoroughly and dry. Goods colored with direct dyes cannot be safely washed with washing soda, strongly alkaline soaps, or bleaching powder.

Acid Dyes. These dyes are so called because they consist of the salts of color acids, usually potassium, ammonium, or calcium salts. When these salts are placed in the dye bath with dilute sulfuric, acetic, oxalic, or formic acids, the color acid is liberated from its salt. These dyes are used to color animal fibers such as silk and wool, because their fibers contain basic properties which cause them to combine with the color acid. Free alkalis rapidly dissolve these colors and therefore fabrics dyed with them may not be washed with laundry soaps or washing powders. These colors, however, do not fade in strong light.

Basic Dyes. The dyes of this class readily combine with acids to form salts. Since silk and wool possess acid as well as basic properties, such dyes unite directly with these animal fibers. But to use basic dyes with cotton and linen requires a mordant, that is, a substance that will unite both with the goods and with the color. Sometimes this is a chemical union and sometimes only physical. The mordant fixes the dye so that it will not wash out. Basic colors are usually very bright and striking but fade rapidly when exposed to the light.

Sulfur Dyes. By the action of sodium sulfide on certain organic substances dyes are obtained which are very fast when exposed to light and which do not wash out. They are used principally with cotton and linen fabrics.

Vat Dyes. The oldest colors known belonged to the class known as vat dyes. Indigo is the best example. Formerly obtained only from the indigo plant, it is now made in abundance and cheaply from coal tar. Through the agency of reducing agents placed in the dye bath, the indigo is brought into solution. Then upon exposing the fabric to the air the dye is oxidized into an insoluble color.

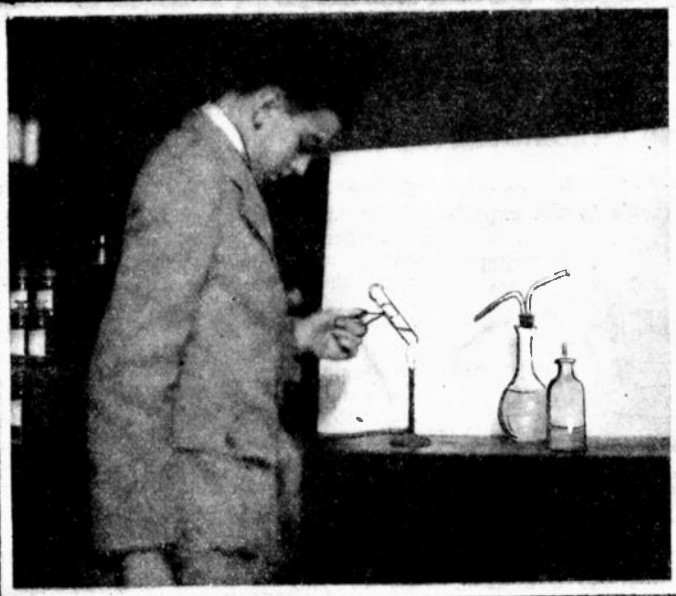
Other dyes are known; such are the very important class of mineral dyes, but the above types are those best known to the trade.

The Use of a Mordant. To learn the use of a mordant prepare a solution of potassium dichromate and place in it a square of white cotton cloth. Upon removal you will observe that it has been dyed yellow. Now place the cloth under the faucet and you will discover that the color immediately washes out. It is not fast. Evidently if this is to be used as a dye there must be some substance to hold it fast to the fabric. Prepare a dilute solution of lead acetate or nitrate. Dip another cloth first in the lead solution and then in the potassium dichromate. Immediately a bright yellow color precipitates in the fabric and it cannot be washed out. In this instance the dye and the mordant unite chemically to form a new color substance which is precipitated all through the fibres.

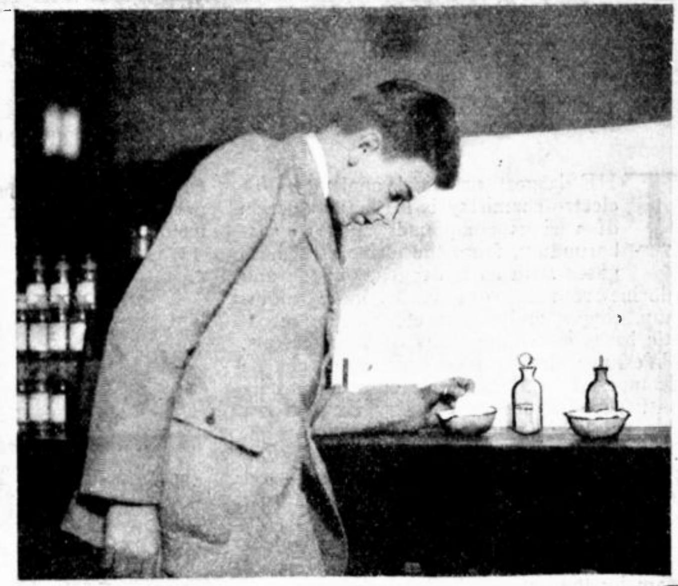
Aluminum Hydroxide as a Mordant. Prepare a solution of alum by dissolving 2 grams of the salt in 100 cc. of water. It is important that this solution be very dilute. Then make a solution of ammonium hydroxide by mixing one volume of strong ammonia water with 10 volumes of water. A logwood solution may be made by dissolving the extract in water and an alizarine bath by simple solution.

If the cotton cloth which you are to use contains sizing, this must be removed by soaking in very dilute hydrochloric acid and then rinsing thoroughly in several changes of clean water.

Now mordant the cloth by soaking it in the solution of alum, wringing it out, immersing in ammonium hydroxide, and wringing again. The alum and ammonium hydroxide unite to precipitate aluminum hydroxide in the fiber of the cloth.



Melting butter preparatory to testing for the presence of artificial coloring matter.



Even chlorine yellow when properly employed makes an effective color not easily washed out.

Follow this process by boiling the cloth in logwood solution. You will find that the cloth has been permanently dyed and that the color will not wash out. Aluminum hydroxide has the property of adhering both to the fabric and the dye.

Repeat this process using alizarine.

Dyeing with Congo Red. Congo Red is a direct dye for use with cotton goods. The first operation consists in removing the sizing from the goods to be dyed as described above. In this operation it is well to make the final rinsing in water containing a few drops of ammonia. This will destroy any acid still clinging to the fiber of the cloth.

Now prepare the following solutions:

0.4 g. of Congo Red in 100 cc. of distilled water;

0.4 g. of sodium carbonate in 40 cc. of distilled water;

0.8 g. of sodium sulfate in 40 cc. of distilled water.

Mix these three solutions in an enameled dish with 220 cc. of distilled water and heat the mixture to boiling. Cut the cloth into strips, thoroughly wet them, and then immerse them in the dye bath. Keep the bath gently boiling during the operation and keep the cloth moving. After a couple of minutes remove the cloth and wash it thoroughly.

If you wish more of the dyestuff to enter the goods, place in the bath some sodium salt such as sodium chloride or sulfate. This is an interesting example of mass action. Congo Red is a sodium salt of an organic acid and the presence of a more soluble mineral salt will cause the less soluble Congo Red to be precipitated in the fiber of the cloth.

Using Basic Dyes. Basic dyes cannot be used with cotton goods without a mordant. Tannic acid combined with tartar emetic is often used as the mordant. The mordanting and dyeing baths may be prepared either in enameled pans or glass beakers.

First prepare the following solutions:

0.5 g. tannic acid in 500 cc. of distilled water.

0.2 g. tartar emetic in 200 cc. of distilled water.

0.1 g. fuchsine in 200 cc. of distilled water.

0.1 g. malachite green in 200 cc. of distilled water.

0.1 g. methyl violet in 200 cc. of distilled water.

0.1 g. methylene blue in 200 cc. of distilled water.

Now bring the last four baths to boiling and place in them strips of unsized cotton cloth. Remove them and wash thoroughly in running water. Is the dye fast?

Next heat the tannic acid bath to boiling and immerse in it strips of cloth for five minutes. Be sure that each strip is kept thoroughly wet by the bath. Upon removing the strips, wring them and place in the cold bath of tartar emetic. This action will form an insoluble substance with the tannic acid, but one that will act as a mordant with the dyes. Keep them in this bath for five minutes.

Rinse the strips thoroughly and place one in each of the dye baths. Boil gently for a minute, then remove, rinse and dry. This time it will be found that the dyes are fast on the fabric.

A Direct Dye for both Cotton and Wool. Make a suspension of the dye Chrysophenin by shaking 1 gram of it with 100 cc. of water. In an evaporating dish place 40 cc. of water and add 10 cc. of the suspension. Also add 1 cc. of a very dilute solution of sodium sulfate. Heat the mixture to boiling. Place in this bath a piece of cotton and a piece of flannel. Stir with a glass rod and heat for two minutes. Upon washing it will be found that the dye is fast in both cases, and without the use of a mordant.

The purpose of the sodium sulfate is to precipitate more of the dyestuff in the fiber of the cloth, by mass action as already explained.

Dyeing Woolen and Raffia Goods Black. Prepare a mordant by dissolving 60 grams of ferrous sulfate (copperas) in a liter of water. Prepare the dye by boiling a quarter of a teacupful of logwood chips in a liter of water for ten minutes. Boil the goods for fifteen minutes in the mordant. Air them and then boil them for an hour in the dye bath. Dry thoroughly, wash out the superfluous dye, and press. A permanent black will be obtained.

Detection of Coal Tar Dyes in Foods. Many substances such as candy, soft drinks, jam jelly, catsup, gelatin, etc. are artificially colored with coal tar dyes.

Dissolve from 20 to 30 grams of the sample in 100 cc. of water and add 10 cc. of a ten per cent solution of potassium acid sulfate. Have at hand a piece of cloth which has been previousy boiled in dilute sodium hydroxide and thoroughly washed in water. Boil this prepared cloth in the above mixture, remove, wash in water, and dry between filter papers. If there is no coal tar dye present, but only coloring matter of vegetable origin, the cloth will either be uncolored or have only a faint pink or brown. If, however, a decided color is obtained coal tar dyes are present.

The success of this test depends largely upon using a very dilute solution of sodium hydroxide in which to boil the sample of cloth to be used.

Coal Tar Dye in Butter. Carefully melt a piece of butter the size of a hickory nut in a test tube. Have ready a mixture of 4 parts of acetic acid and 1 part of sulfuric acid. Add to the melted butter an equal volume of this reagent and shake vigorously. Then heat nearly to boiling and allow the contents of the test tube to settle. If coal tar dyes are present the acid, which settles in the bottom of the tube, will be wine red in color.

Detection of the Vegetable Dye Cochineal. If the sample is a solid or semi-solid as catsup, canned goods or similar foodstuffs first reduce it to a thin paste by triturating it in a mortar with a little water. Filter and to the filtrate add a little hydrochloric acid. Then shake in a test tube with amyl alcohol. If cochineal is present the alcohol will be colored a yellow or orange color.

The subject of dyestuffs is a very big one. Upon it and its allied industries depended much of the success and failure of the Great War. And it has been wholly a problem of chemistry. It is but another illustration of the tremendous and ever growing importance of chemistry in every phase of art and industry.

Nitrogen Stops Transformer Explosions

Large transformers which are used in all high voltage lines to step-up or step-down the current are filled with oil to carry away the heat generated in the inside coil.

The new principle, as worked out by Mr. Dann, consists of filling the transformer case above the oil level with nitrogen. Nitrogen, a harmless and inert gas, lies over the top of the insulating oil like a blanket and prevents the forming of an explosive mixture with the oil vapors arising from the oil. An ingenious device of simple design attached directly to the transformer generates a constant supply of the gas. Automatically filling the space above the oil level with the protecting layer of nitrogen, no oxygen, which is the element needed to produce the explosions or start a fire, can enter.

Experimental Electro-Chemistry

By RAYMOND B. WAILES

PART V—ELECTRO-CHEMICAL PREPARATION OF LITHIUM, AMMONIUM AMALGAM, NITROGEN CHLORIDE, ETC.

THE largest practical application of electro-chemistry is in the production of various compounds such as carborundum, from the electric furnace, gases such as hydrogen, oxygen and chlorine from electrolytic cells, and of aluminum, copper and silver, etc. from electrolytic baths containing salts of these metals.

We have already seen how water can be decomposed by the electric current into its constituents, hydrogen and oxygen gas, if a little sulphuric acid has been added to it. The water in this experiment was liquid. It can also exist as a vapor—steam—and the electric current will decompose it just as readily.

Figure 1 shows how the two gases, hydrogen and oxygen, can be generated from steam by the action of the electric current. A Florence flask is fitted with a one-hole cork and two wires are thrust through the cork as shown. The wires form a miniature spark gap, for the current necessary to decompose steam acts at greater potential than that used in the decomposition or electrolysis of liquid water. The secondary terminals of a spark coil, S should be connected to the gap. A bent glass delivery tube should be connected with the flask and an inverted bottle filled with water as a receiver, the bottle being placed in an improvised pneumatic trough as shown. The flask is supported by a piece of wire gauze, W, resting on a ring R of the ringstand.

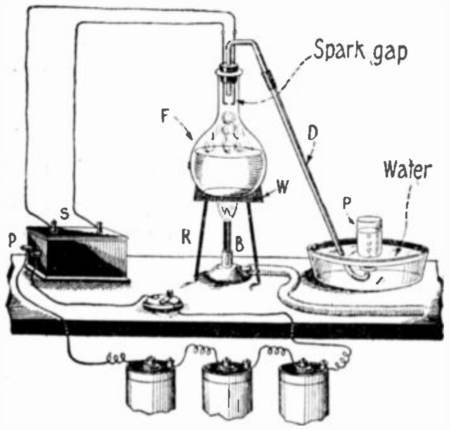


Fig. 1

The two gases, hydrogen and oxygen, can be separated from steam by the action of electric current. The apparatus is set up as shown above.

When a copious evolution of steam is produced and the contents of the flask are boiling violently, the bottle is to be moved over the mouth of the delivery tube and the spark coil operated. The spark jumping the gap will cause a decomposition of the steam into hydrogen and oxygen, the mixed gases passing into the bottle. The pressure on the inside of the flask expels the explosive hydrogen-oxygen mixture as fast as it forms. Shut off the spark coil through switch SW before removing the flame from the flask. The contents of the bottle can be proved to contain hydrogen-oxygen gas by introducing, at a distance, a lighted taper.

NITROGEN TRICHLORIDE

Nitrogen trichloride is an oily liquid having the formula, NCl_3. It is a very dangerous explosive, but small quantities of this interesting compound can be prepared with ease and without danger by simple electrolysis. The resulting product, nitrogen trichloride is exploded as fast as it forms in this experiment, but only after its peculiar properties are made visible to the experimenter.

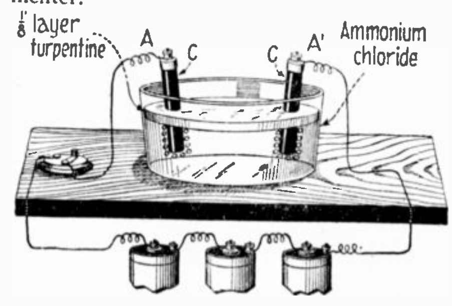


Fig. 2

Nitrogen tri-chloride, a dangerous explosive, is produced by the reaction of chlorine with ammonium chloride, the nascent chlorine being developed electrolytically.

A shallow tray, such as a developing tray, is filled with a strong solution of ammonium chloride (sal ammoniac), and after cooling to room temperature, is covered with a one-eighth inch layer of turpentine. See Fig. 2. Carbon electrodes are used and are connected to a storage battery capable of producing about 8 or 10 volts. The wires A-A' leading to the electrodes are bent over the sides of the electrolyzing vessel as shown. A sheet of tin or asbestos should be handy, so that in case the turpentine should inflame, it can be extinguished by placing the sheet over the whole vessel, thereby excluding air necessary for the combustion.

When the current is passed, chlorine gas is liberated at the positive pole, and in the nascent, or newly born state, reacts with the ammonium chloride surrounding the electrode and forms nitrogen trichloride. The nitrogen trichloride will rise to the top of the solution with the ascending chlorine bubbles and when contact forms between it and the turpentine, a small harmless explosion will result.

A small bit of the nitrogen chloride might escape being carried to the surface by the chlorine bubbles and might fall to the bottom of the vessel. At the conclusion of the experiment, the solution should be made strongly ammoniacal with ammonia, (ammonium hydroxide) until the oily drop completely disappears.

METALLIC LITHIUM BY ELECTROLYSIS

Lithium is a soft waxy metal resembling silver in color. When dropped on water it decomposes, forming hydrogen gas, and lithium hydroxide, the latter passing into solution.

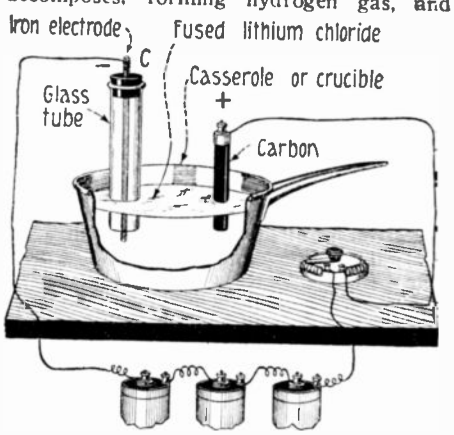


Fig. 3

A molten electrolytic bath of lithium chloride will, upon electrolysis, produce the soft waxy metal resembling silver in color, known as lithium.

Copper can be prepared by electrolysis of an aqueous (water) solution of copper sulphate, the copper depositing out on the negative electrode. If the attempt was made to obtain lithium to be prepared by a water solution of one of its soluble salts such as the nitrate, the lithium would react with the water of the solution as fast as formed, and not the least trace of metallic lithium would be obtained. It can be seen therefore, that the electrolysis bath cannot be aqueous in this instance. The difficulty is overcome by using a *molten* electrolytic bath of lithium chloride.

The apparatus used is shown in figure 3. A porcelain casserole or a large porcelain crucible (100c.c.) is suitable for the reaction vessel. The anode is an iron rod thrust through a glass tube and held in position by a one hole cork stopper. The iron rod electrode should protrude about a quarter of an inch below the glass protection tube. The cathode is a carbon rod. The positive element from a flashlight battery serves admirably for this purpose. The storage battery should be controlled by means of a rheostat. Of course, the direct current from a 110 volt lighting circuit can be used for this and all other electrolysis experiments. In this case it is necessary to use resistances such as lamps in parallel to *pull* the amperage through the circuit, the electrolytic cell being connected in series with the parallel-connected lamps.

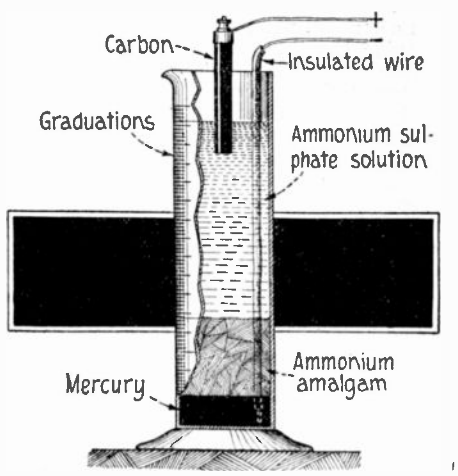


Fig. 4

Ammonium amalgam can be prepared electrolytically. Mercury is placed in the bottom of a graduate, and ammonium sulphate solution poured on top of this. The ammonium amalgam is produced between the metal and liquid stratas.

The lithium chloride is mixed with 1/5 its weight of potassium chloride and introduced into the porcelain vessel and the vessel is heated by means of a Bunsen burner until the lithium chloride fuses. When it is melted the current should be started. In about a quarter of an hour the portion of glass tube between the iron electrode and the tube can be seen to be filling with metallic lithium. When about half an inch has accumulated, the electrode wire should be detached at C and the iron electrode *with its glass protection tube* lifted from the bath, cooled ever so slightly in the air, and thrust under the surface of kerosene contained in a bottle. A jerking motion imparted to the glass-iron combination electrode will remove the mass of lithium from the tube, as the

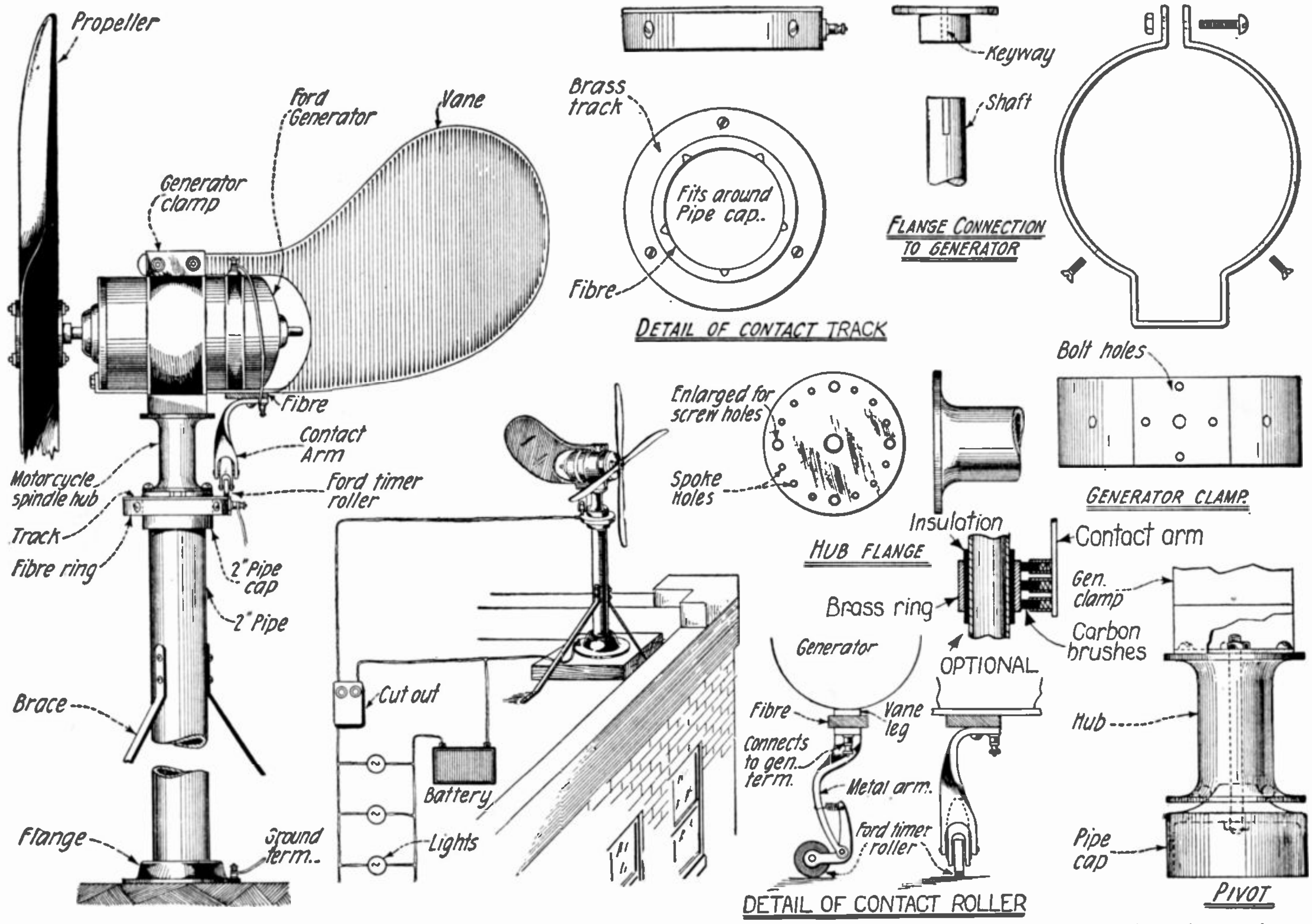
(*Continued on page* 1005)

Wind-Driven Electric Lighting System

By L. B. ROBBINS

MANY persons living in communities not furnished with standard electric current, would like to have a few electric lights in the barn, workshop, camp, or in a room where electric illumination would be particularly convenient and much safer than oil lamps. Commercial house lighting plants, for very small installations, are costly, but this outfit will light up three or four 6-volt automobile headlight lamps with but very little expense, and is practically self-operating. It is driven by the wind and in conjunction with an automobile lighting battery will give steady and continuous current for many hours, whether the generator is in operation or not. As there is usually some breeze blowing, the battery will be kept sufficiently charged, keeping it up to its proper voltage and capacity, provided, of course, that some attention is given to the number of hours the lights are operated during calm periods.

A Ford generator, which is easiest to procure, will give good results, if in fair condition, although others could be employed, provided that they are in good working condition. One could be purchased at any automobile service station for a small sum. See that the brushes are in good shape, and if necessary, substitute new ones. It is better to test it out thoroughly before assembling, to make sure that it delivers its maximum load. Remove the driving pinion from the shaft and deepen the key-way slightly to withstand the strain of the air propeller, which is to be used to rotate the armature. Turn out a flange from tool steel to take the place of the pinion. This should have a heavy collar to seat on the shaft and the flange itself must be of the same size and dimensions as that on the propeller. A three-foot propeller will be about right for this purpose, and can be purchased from any airplane supply house or can be turned out by the mechanic himself. If the latter is necessary, make it from a piece of 4x6-inch spruce, using the 4-inch side as the thickness, and the 6-inch as the width. Be sure the blades are fashioned and pitched so as to drive the armature in the same direction as was done in the car. Where the propeller is home-made, the two flanges can be made identical and should be perfectly balanced. If in either case, the propeller tends to wobble, adjust that by taking up on one or more bolts connecting the flanges, and see that the tips of the blades are in balance, which can be adjusted by shaving off wood from one or the other. The matter of using a two, three, or four blade propeller must be left to the judgment of the builder. The prevailing velocity of winds in his particular location will be a deciding factor in this case although an uncertain factor.

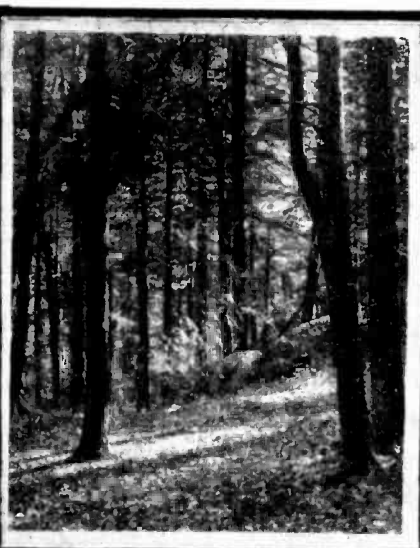


Those of us who desire to experiment with small lighting outfits or who live in country sections where electricity is not available, will be interested to learn how a simple, wind-driven electric lighting system can be built. The system shown above in detail, made use of an old Ford generator, a propeller, a motorcycle hub and incidental pieces of pipe and metal. The details of construction are given in the accompanying article.

When the propeller is attached and in perfect balance, you are ready to mount the generator upon the swivel. First make a clamp of heavy sheet iron for the generator. The idea is shown in detail. Two lugs are left at the top for the tightening bolts, and a rectangular portion fashioned at the base, which will clear the bottom of the generator by at least 2 inches. The width will depend upon the diameter of the flanges of the motorcycle spindle hub to be used for the swivel proper. It should be a trifle wider. Also drill and countersink two holes, as indicated; screws are used here to fasten the clamp to the sides of the generator. Corresponding holes must be drilled and tapped in the generator shell.

Before attaching, make a vane of thin but stiff sheet steel or aluminum, if it can be

(Continued on page 1003)



Photographs such as these can be made by the average amateur photographer, by simply following a few rules.

Three of the photos shown here are still life pictures, in which the shadow and high lights are not strong enough to become offensive to the eye. By increasing the time of exposure, such effects become possible. Note the soft mellow tones of the photograph at the right.

How to Use Your Camera

By Dr. ERNEST BADE

PART II—LANDSCAPE PHOTOGRAPHY, WHAT TO DO TO GET RESULTS

THE taking of any kind of a picture presupposes a knowledge of the laws of effect. Simply pressing the button of the camera shutter may give an exposure and produce a picture, but even in photography there is a great difference between picture and picture. The representation of any object gives us a double impression, one of them affecting the eye, the other the imagination. The final picture must, primarily, give a visible effect of unity, and this is always obtained by simplicity. For this purpose an equal distribution of objects becomes a necessity and this requires patience before such a pictorial segment is found. A bit of Nature flaming in the bright light of the sun with all its many gradations of deep shadows and high lights, gives, apparently, a wonderful picture. But when all this has been translated into black and white, the effect is far different. Such a photo is a fragment without unity and without simplicity. It tells us nothing, it is worthless, and its final effect does not measure up to our expectations.

The story that is told by a landscape is entirely different from that told by a portrait. The former must recreate that feeling which existed when the picture was taken and such motives are rare. It is the condition in which the motive appears at the time when the picture was taken in conjunction with the mood, which makes for the beautiful, artistic photograph.

As a rule it will be necessary for the amateur to make a good picture from the material before him. But this is by no means so easily accomplished. The painter may bring forth or repress any desired object by means of his colors, shading or lighting those parts which aid or destroy the effect. The photographer on the other hand must make use of the distribution of objects in space, lighting effects, and the background. The nature of the motive to be taken depends upon circumstances. A gradation of the fore, middle and back grounds will generally be sufficient to bring forth the motive effectively. A street, with all its houses sharply and correctly defined in sun or daylight, will rarely give an artistic picture. But when a fog lies heavy, the outlines of the houses are hardly discernible, and the light of the foreground is broken by the puddles in the street, then such a picture gives an impression of dampness, for the fog with its moisture-laden atmosphere is here the prime factor; the motive, the street, is of secondary importance.

In the shade of the cool forest while the sun burns in the fields and meadows, the changing play of light and shadow works its charm and few can resist the temptation to hold this impression on the plate. The motive does not have to be sought, in fact when it *is* sought the mark of artificiality is stamped upon it. Before taking the picture the impression that the selected place makes upon the imagination must be felt. This selection is not always easy, the most beautiful and simplest objects are too often passed unnoticed. Too much is generally placed upon the film, giving final results which are extremely poor, lacking as they do, the charm of a woodland scene. A trained eye is necessary to distinguish the suitable from the unsuitable, only then is it possible to get a satisfactory result. When the rays of the sun break in the crowns of the trees and the lights play hide-and-go-seek in the underbrush, the entire picture in all its shades of color is entrancing. But in the taking of such a picture the most foolish of all mistakes are made. The forest is deficient in light, and, although this fact is by no means new, it means, translated into practical photography, that a comparatively long exposure is here a necessity.

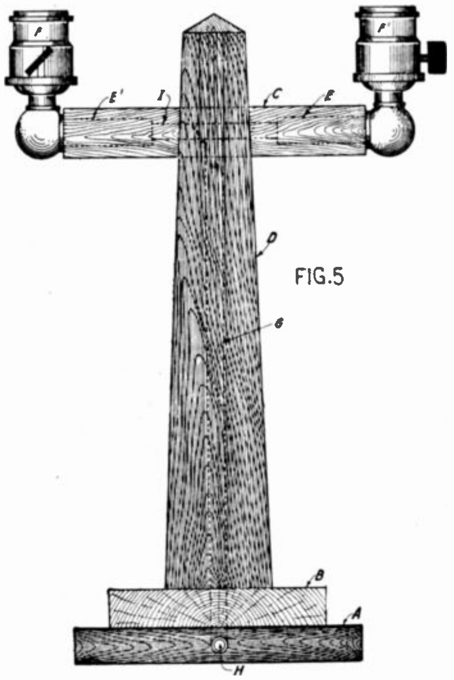
In all pictures taken in the forest the places struck by light will be over-exposed when the shadows begin to be formed on the plate. This is by no means objectionable and does not influence the finished plate adversely. On the other hand, if the exposure was normal, the shadows would be jet black and the light parts snow white, giving an entirely wrong impression of the scene. Therefore, when taking pictures in the forest, theory and practice clash, the former giving precedence to the latter.

Woodland scenes can only be taken when the air is quiet so that a time exposure can be made. This becomes imperative when much underbrush is present. When this is struck by sunlight during the exposure, weird light spots will be produced making an execrable combination of black and white. But when such an underbrush is taken in the correct perspective, it gives a wonderfully artistic effect.

(*Continued on page* 1008)

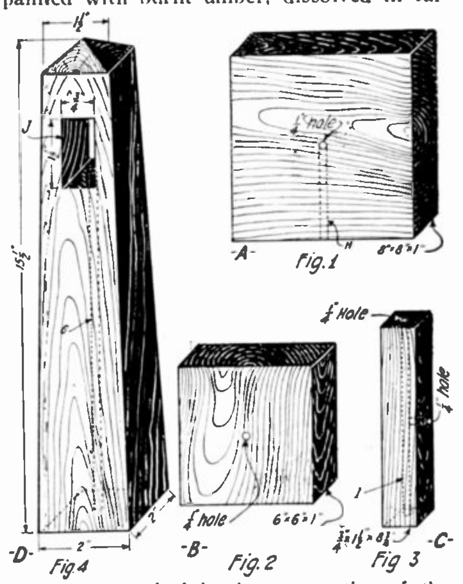
Mission Library Lamp

Having recently constructed an electric table lamp of the mission type I thought I would pass on the information, so that others could build one for their own purposes.



The rather attractive mission table lamp shown above can very easily be made by the average amateur.

The drawing explains in detail the parts necessary, and shows the final assembling of the lamp, consequently, I will not elaborate this description. A piece of soft pine, preferably, is first secured, although hard wood may be employed in the construction of the lamp. Personally I have found that soft pine answers the purpose, and it is much easier to handle. A base is cut therefrom, measuring 8" x 8" x 1", smoothed and sandpapered on all sides. The edges are beveled off, and then a hole H, as shown in Figs. 1 and 5, is drilled from the edge to the center. Here a vertical hole connects with the other opening. A second piece of wood, 6" x 6" x 1", is treated in the same manner, and then a hole is drilled in the center to meet the hole in the 8-inch piece. The transverse piece or crossarm is now made. This measures 3/4" x 1 1/2" and may be made of any length desired. A length of 8 3/4 inches is quite favorable. A 1/4-inch hole is drilled through this lengthwise and then in the center another transverse hole is drilled to meet the first hole, as shown in the illustration. The upright piece is now constructed from a 2-inch piece of stock, which is planed down to 1 1/2 inches at the top. A point is constructed on this thinner end, and the piece cut off, so that the over-all dimensions will be 15 1/2 inches. From the base another hole is drilled, 1/4 inch in diameter G, Fig. 4, which extends to within 3 inches of the top. A slot 3/4" x 1 1/2" long is cut into this upright piece near the top. This slot J, will permit the piece in Fig. 3 to slide snugly into the same. Care must be taken to see that the holes in these pieces line up. Two key or keyless sockets F,F' are now procured, which are fastened to ornamental elbows, the opposite ends of which are secured to 1/4-inch iron pipes, preferably 2-inch long (E,E'). These may be pushed into the wooden cross-piece after a small quantity of glue has been placed upon them, so as to hold them rigidly in place, but before doing so, the rest of the lamp should be assembled, by gluing the parts together, as shown in Fig. 5, and the wire to both sockets connected in parallel should be drawn through the holes H, G and I. Screws may be used to hold the base and upright together. If the lamp is painted with burnt umber, dissolved in turpentine, which color is permitted to stand for about fifteen minutes and then wiped off, it should be again sandpapered with No. 10 sandpaper, then varnished and allowed to dry. Repeating this process several times, that is varnishing and sandpapering the lamp, gives it a wonderful piano finish.



The parts required in the construction of the mission table lamp shown at left are some one inch pieces of wood, and a longer piece, two inches in thickness. If made of hard wood and rubbed down and polished carefully, this library lamp, requiring but a few hours to construct, becomes a very valuable acquisition to any home.

Contributed by George Sutters, Jr.

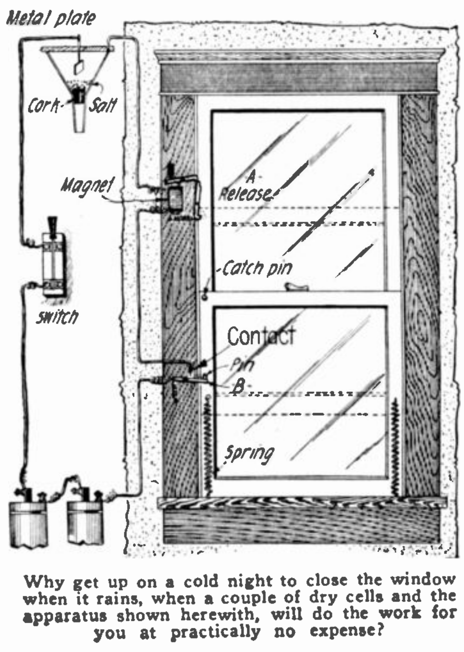
Automatic Window Closer

Often when sleeping with open windows, rain drives in and causes much annoyance. Rain alarms, which operate electric bells, are widely used to prevent this, but these often interrupt a good night's sleep or peaceful dream. To do away with this annoyance, I built the following device, which automatically closes the window.

Most of the details can be obtained from the drawing. The releasing device (A) is located at the height to which the sash is usually raised. In case of rain, the rain alarm operates the magnet which, in turn, releases the sash, which is immediately drawn down by the springs. A switch (B) is arranged, as shown in the illustration, so as to break the circuit when the sash descends, the switch being opened by a projecting pin on the sash. This preserves the life of the batteries. A strip of felt or rubber is fastened to the bottom of the sash, so as to prevent any noise when the window closes. The large springs can be attached so as to be easily removable. If the window does not work easily, it should be taken out and planed down until it does.

Any rain alarm previously described in this magazine could be employed. The one made of a metal funnel corked at the bottom with a plate suspended within the funnel, as shown in the illustration, and salt sprinkled in the bottom, was found quite reliable. The top sash can also be fitted up in the same way for those who open both the top and bottom of the window. Should the reader object to the spring arrangement, the sash could be weighted by drilling holes along the edges and pouring lead into the same, after which the sash cords and counterweights are removed. The window then closes by gravity.

Contributed by Edgar W. Fritz.



Why get up on a cold night to close the window when it rains, when a couple of dry cells and the apparatus shown herewith, will do the work for you at practically no expense?

Pocket Code Instrument

VEST POCKET CODE INSTRUMENT

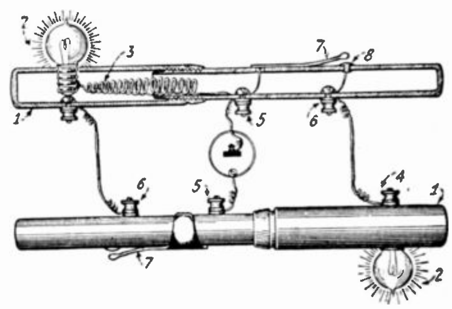
This device is small and light and can be put into the pocket in the same manner as a fountain pen.

The parts used in its construction are as follows: An old self-filling fountain pen case, an ordinary flashlight bulb, three small binding posts (4, 5, 6), a movable pen clip (7), and a copper wire spring.

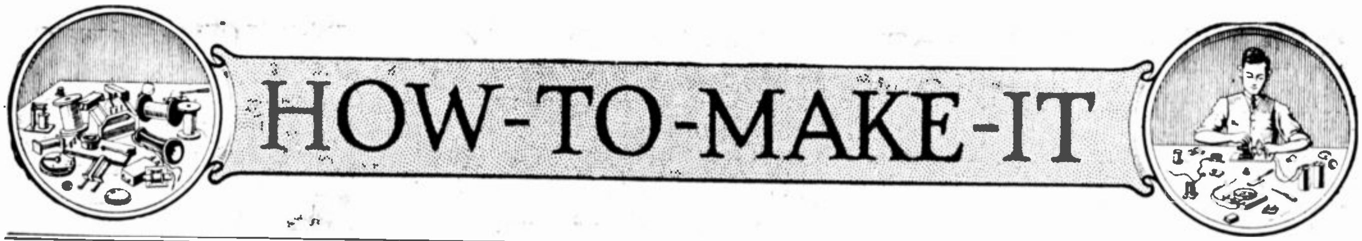
In making the instrument care must be taken not to use too large tools in cutting the holes, as the hard rubber case of a pen is very brittle.

The hole for the bulb (2) should be just large enough to permit the base to enter. The bulb is held in place by the copper wire spring which also serves as a contact. The wire from the binding post (5) is connected to the clip (7), acting as a key. The wire from 6 forms a contact when the key is pressed. The device may be worked on an ordinary flashlight battery carried in the pocket. By connecting the wires with 4 and 6 the set may be used for practice. By connecting with 4 and 5, messages may be received, and by connecting with 5 and 6 messages may be sent to another similar outfit some distance away. The hook-up for two individual stations is also given.

Contributed by Willet T. Conklin.



Two discarded fountain pens fitted with binding posts and miniature incandescent bulbs, make a very simple inter-communicating telegraph outfit, or blinker set.

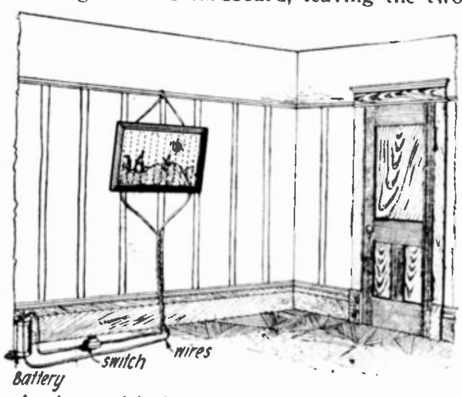


This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $15.00

ELECTRICAL SPIRIT WRITING

This is an interesting electrical trick which will mystify most people. Procure a picture frame, one about 4" x 6" will do, and let the cardboard in the back remain. Coil, as in Fig. 1, No. 28 German silver wire against the cardboard, leaving the two



At the magician's command, a picture gradually appears on what was previously a plain white sheet, and disappears again when desired. The resistance wire in back of the frame causes the cobalt chloride with which the picture is drawn, to take on a blue tint due to the effect which heat produces upon that salt. Of course, in the presentation of this trick, the wires leading to the switch or push button and the source of current supply are concealed.

ends protruding from the back. Now paste over this a sheet of paper, completely covering the wire, and tack a piece of black cloth on the top sufficiently large to cover the frame. When this is finished, cut several sheets of paper to easily fit within your picture frame. Now dissolve one-half teaspoonful of cobalt chloride in one-quarter of a glass of water. With this solution, write or draw any pictures you may think appropriate on the papers that were cut out. Writing is done with a clean gold pen, or a brush with quill (not metal) mounting may be used. The writing is invisible, but under the influence of a gentle heat it will appear in colored blue lines and surfaces. A few batteries and a switch is all that is necessary to complete the apparatus.

The performer should now hang the picture frame against the wall, and draw the curtain back. After announcing that he has command over a spirit who will write or draw for him, he places a prepared paper (drawing face inward) against the sheet which covers the wire. He then lets the curtain drop and turns on the hidden switch, which may be under the carpet or on the back of a chair. A minute later the switch is turned off, the curtain is rolled up, and the picture is removed. A picture where none was before will appear, completely mystifying the audience.

The German silver wire having been gently heated by the current from the batteries, causes the image on the treated paper to appear. Care should be taken in proportioning the current, so that the heat developed is not great enough to set fire to the whole outfit, surprising your friends more than ever. However, with a little care, the trick will terminate effectively.

Contributed by MANSELL SARGENT.

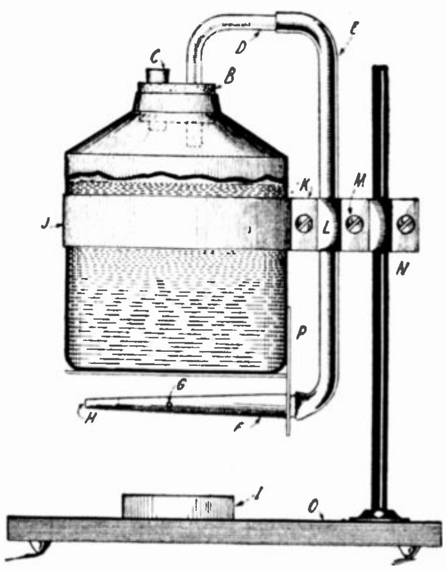
SECOND PRIZE, $10.00

ALCOHOL BLAST LAMP

Here it is, brother constructors, take a look. The idea is an old one, but it may be unfamiliar to some experimenters. A glance at the drawing and a few details, plus the junk usually found in your laboratories and a little ingenuity equals this highly efficient and neat alcohol blast lamp. A is an ordinary oil can (a new one is better in appearance). B is a rubber cork to fit aperture and drilled to fit C, which is a conical plug of lead fitting loosely into a hole of similar shape, and acting as a safety plug. D is a curved piece of metal tubing, and E is a length of rubber tubing. (D and E can be made of one piece of copper tubing). F is the nozzle of the oil can with the cap cut off. G is a tiny hole made with a needle point. The outlet H is stuffed with fire clay for about one-half inch. I is a cup, sunk part way into the base. (You can use the lid of a baking powder can.) J is a band of metal. K and M are clamping screws. N is a metal rod to support the can, and to vary the height by loosening M. O is the tin sheeting covering the base to prevent fire. P is a strip of metal, bored and soldered to A, supporting F.

To charge the lamp, pour a little alcohol through C or remove the cork. Then place some in the cup I. Now light the latter, the heat of which slowly vaporizes the alcohol in A, which in turn passes through P, E, and F, and emerges at G, where it is ignited by I. My lamp gives me a foot colorless, intensely hot blast about a foot long. If properly constructed, I am sure all those built will give satisfaction.

Contributed by MARION J. BOSTAPH.

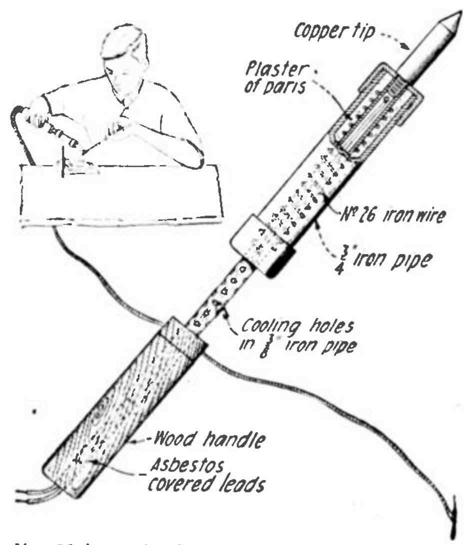


Above is shown a simple alcohol blast lamp which cannot explode. It produces an extremely hot flame sufficient at least to melt glass, and do light soldering. A lead stopper made in the form of a cone, acts as a safety valve, so that when pressure within the can becomes too great, the valve opens, permitting the confined gases to escape.

THIRD PRIZE, $5.00

AN EFFICIENT HOME-MADE SOLDERING IRON

A soldering iron that will meet all the needs of the experimenter is offered herewith. It is made of a ⅜-inch pipe, around which is wound about ten feet of iron wire. Other types of resistance wire will be found more durable, but are a little more expen-



No. 26 iron wire is the heating element of this soldering iron, made from two pieces of iron pipe and a couple of pipe caps. A copper tip purchased at the hardware store is inserted into one of these caps. Note the holes drilled into the ⅜ inch iron pipe to keep the handle cool.

sive. The pipe is first tapped to the size of the tips to be used. It is then wound with mica (about the thickness of several sheets of paper) for a distance of 5 inches from the tapped end. It is then drilled as shown in the diagram. Next the winding, which consists of No. 26 iron wire, spaced about ⅛ inch apart, is put on. The asbestos leads are fastened to the winding outside the tube, each lead being led through a hole in the pipe, as shown in the diagram. The case consists of a ¾-inch pipe and two pipe caps. In one pipe cap is drilled a hole large enough to fit the pipe. In the other cap a hole is drilled large enough to admit the screw on the tip. Pieces of such pipes may be obtained at small plumber's shops or very often around newly erected buildings. The diameter of the smaller pipe given above is the outside diameter, and that of the larger pipe is the inside diameter. The asbestos leads may be purchased at any electrical store at a cost of four or five cents per foot. The space between the winding and the outside case is filled with plaster of Paris, which is mixed to the consistency of cream and poured into the space. The same applies to the hole in the iron pipe used as the core. If that part of the core which is exposed is then drilled with holes, the handle will remain cooler. The handle may be anything about the experimenter's laboratory. Never test for *shorts* until the plaster is dry, as wet plaster is a fairly good conductor. I have used the iron for two months.

Contributed by NORMAN J. MARTIN

HOW TO ANNEAL LARGE AND SMALL TOOLS

Tool steel for making various tools used by experimenters, must be annealed so that it can be filed or machined to the desired shape, as it is too hard to work to advantage when received from a mill or stock house; this is due to the rapid cooling it undergoes on the hot-bed during process of manufacture. An excellent method of annealing small tools which have become broken, as well as for making new ones from different sizes of bars within the capacity of a vise is as follows:

Get two pieces of planed boards, each having one surface perfectly smooth. Hold them up edgewise to the light and try to look through the space between them, the idea being to have as close a fit as possible between the joints for the exclusion of all air in order to obtain perfect annealing results. Next heat your metal to a cherry red; no higher temperature is advisable as it is apt to burn and ruin it. Care must also be taken that the heating is evenly done with no black spots showing. Open up your vise sufficiently so as to permit the boards to stand upright, then insert the red hot metal between the smooth sides of boards and quickly screw the vise up tightly until the boards touch. The hot steel will burn a pocket into the wood with charcoal edges surrounding it, which not only insures slow cooling, but also excludes the air. Large and awkward shapes of steel bars should be heated to the above temperature and buried in ordinary dry powdered quick lime, being left in the latter for twenty-four hours or until cold. Both the board and lime methods of annealing prove very effective and produce good results. To temper the tools after putting them into shape, nothing is better than the following simple formula for a tempering compound which experience shows to be excellent. Heat your metal to a cherry red in the usual way, and quench it in vinegar; in quenching, don't plunge the metal entirely in your solution but leave some heat in its shank, then quickly rub one side of its point bright with a file and watch the colors travel towards its point until a blue is reached; a sharp file at this stage ought to be able to just barely scratch its surface. Next plunge all of the tool into the vinegar in an unright position so as to prevent any warping tendency. The acid in the vinegar toughens the steel to such an extent, that if the steel is of fine quality and the tempering rightly done, you can drive a chisel thus made through a one-fourth inch wrought iron plate with a sledge hammer without breaking a piece out of its edge. In handling high speed steel, the maker's directions for tempering and hardening this metal should be followed, as it contains special ingredients, one manufacturers directions for hardening and tempering, may not work well with another brand.

Contributed by W. C. Standiford.

PROTECTION FOR BOTTLES

Lengths of old tubing cut and fitted over bottles of aerated waters are easily stored in the locker of your car or hamper without fear or damage, and if the bottles are of the old glass or rubber stopper type, this cover serves as a protection against damage to yourself when opening. The tube should be left on the bottle, then accidental breakage of the bottle if held in the hand, will not injure the person.

Contributed by W. O. Edema.

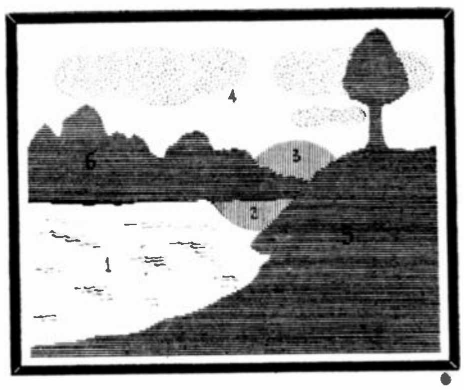
THIS MONTH'S $5.00 PRIZE

MAGIC "SETTING SUN" PICTURE

There is no magic so mysterious as the magic of chemistry. In the laboratory, we constantly obtain effects which, on the stage, would be regarded as little short of marvelous. This is amply demonstrated by the trick which we shall call "The Setting Sun Picture."

Effect: The magician, using a clean sheet of white paper and an improvised brush as the utensils of an artist, together with a vial of water as the paint, produces a beautiful landscape in colors. The scene is a cerulean lake, set between rocky shores. An intensely red sun illuminates the sky, reflecting itself in the water; then, before the eyes of the audience, the sun slowly fades from the sky, leaving only the unbroken calm of the placid lake.

Explanation: On a clean sheet of white paper, outline a picture similar to the one shown in the figure with a light pencil. Paint the sections marked 1, 2, 3 and 4 with a saturated solution of copper sulphate, using



The picture of a setting sun as illustrated above, is made in but a few seconds, by washing a clean sheet of paper with what the audience believes to be pure water.

a soft camel's hair brush. Paint sections 5 and 6 with a 1:10 solution of mercurous nitrate in water, being careful not to overlap the already painted sections. Let each solution dry before proceeding to the next and keep your brush clean. Then paint sections 2 and 3 again, this time with a 1:100 solution of phenolphthalein in 50 per cent. alcohol. If the paper is not free from color when dry, warm it gently, taking the proper precautions against charring. Erase the pencil lines.

The *water* used is ammonium hydroxide. Tie a pocket handkerchief to the end of your wand (which is merely a length of glass tubing) and smear the ammonia over the surface of the picture with this. By thus proceeding, the sky and water will come out blue, the rocks and bushes a peculiar drab color and the sun, of course, red. The first two colors are permanent, but the red of the sun soon fades, owing to the escape of ammonia gas. Hence the appellation, "Setting Sun."

Other combinations can be worked out by the reader.

Contributed by Chas. D. Tenney.

SYNTHETIC SMELLS

The chemical experimenter who likes to diverge from the regular routine of experiments will welcome the following: The apparatus is the same in each case; a distilling flash equipped with thermometer, Liebig's condenser and receiving flask.

APPLE BLOSSOMS: Pour into the distilling flash 20 c.c. of acetic acid, 10 c.c. of sulphuric acid, and 6 c.c. of ethyl alcohol. Mix well and heat gently. Ethyl acetate or artificial oil of apple blossoms distills over around 80°.

PINEAPPLE: Melt fifteen grams of butter in an evaporating dish or casserole and add slowly with constant stirring, 5 c.c. of strong sodium hydroxide solution (1:1). When a good emulsion is obtained, heat the mixture cautiously over a low flame, stirring until it begins to boil. Continue the heating and stirring until the mixture becomes thick and homogeneous. Dissolve the soap formed in 100 c.c. of water, transfer to distilling flask, acidify with 25 c.c. of sulphuric acid (1:4), and distill about 15 c.c. Clean flask and add distillate, together with 10 c.c. of ethyl alcohol and 5 c.c. of sulphuric acid. Heat gently and soon the distillate, artificial oil of pineapple, will distill over and collect in the receiver

WINTERGREEN: Dissolve a spoonful of salicylic acid in 5 c.c. of methyl alcohol in an eighth-inch test tube. Add 5 c.c. of concentrated sulphuric acid and boil cautiously for a minute. The odor of wintergreen will be noticed immediately.

Contributed by J. Louis Oberseider.

A FOUNTAIN PEN TIP

Having had a fountain pen where the screw thread on the inside of the barrel had worn to such an extent that the part carrying the nib was quite loose; a very effective repair was made as follows.

A piece of thread was wound round the barrel firmly and evenly on the outside part where the worn threads were in the inside of the barrel. This portion was then immersed in hot water for a few seconds and then plunged into cold water.

When immersed in hot water the composition of which the barrel was made softened and the wetting of the thread caused the thread to shrink and tighten, and when immersed in cold water it hardened the material. This resulted in raising the worn threads above their former position. This method could be applied to similar cases where articles are made of vulcanite, etc.

Contributed by W. O. Edema

A cord of wood contains eighty-five cubic feet of wood and forty-three cubic feet of air. A pound of dry wood gives 7,000 to 9,000 British thermal units, while a pound of coal will give 12,000 to 15,000 such units.

The Government Bureau of Standards, in testing automobile tires, have found that the cord tires stand up better than those of fabric because the cords run diagonally and the wear is much less than when the fabric is pressed down at right angles. Heat in a tire is generated chiefly by the pressure which bends the tire down. With a four inch tire running at twenty-five miles an hour six-tenths of a horse-power is lost in bending down the tire.

Motion Pictures Via Radio

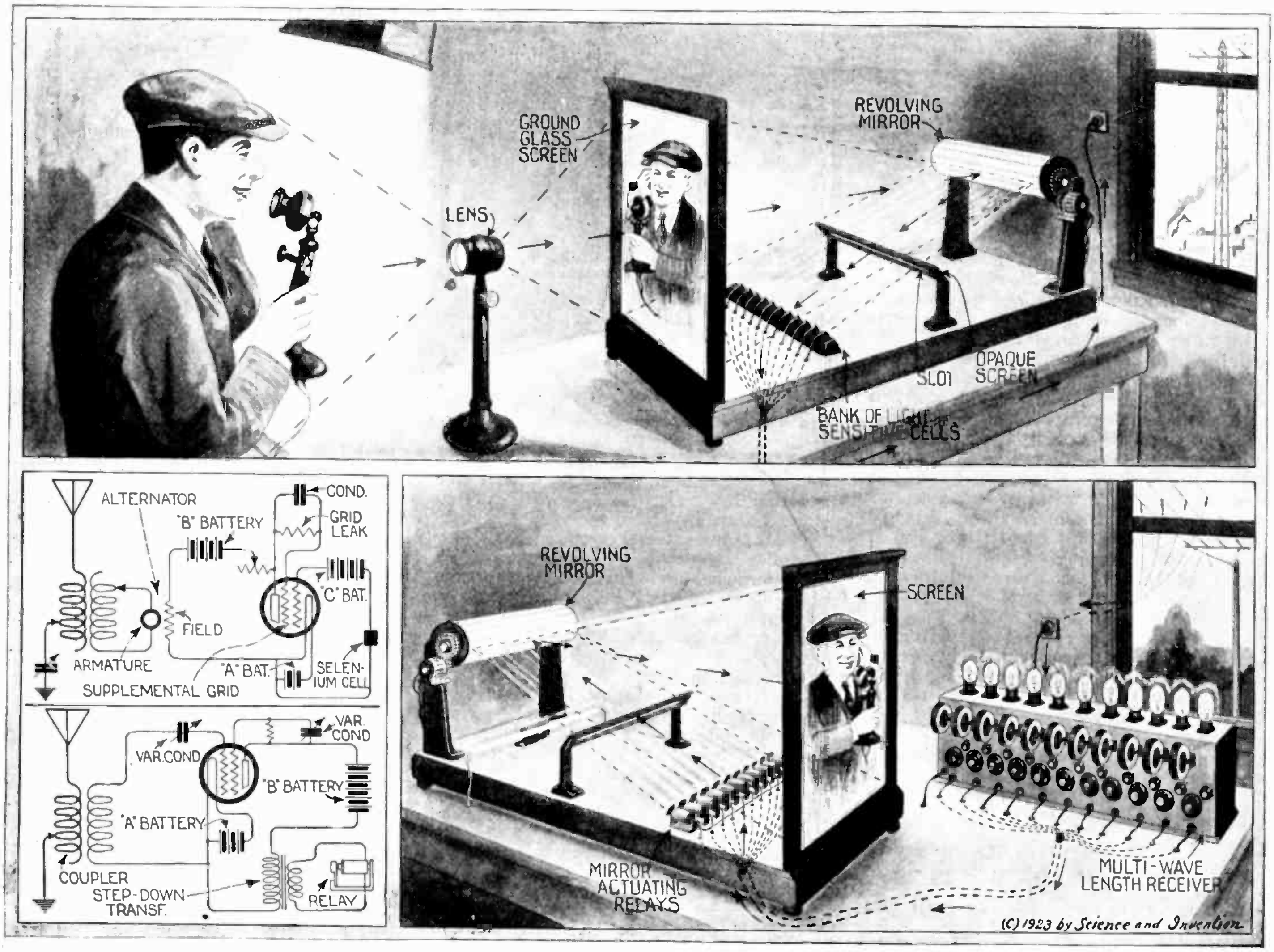
By JOSEPH H. KRAUS

A VERY interesting method of transmitting pictures by means of radio has recently been patented, and for the benefit of those of our readers who are interested in new developments in the radio field, we are illustrating the process and giving the details of the construction. In this method, invented by Henry K. Sandell, of Chicago, we find a possibility of producing motion pictures at a distance, the process itself being very simple, indeed, and offering no difficulty to the average experimenter, who might desire to reproduce the same on a small scale, using the principle here involved. In Fig. 1, the picture of the individual, either at rest or in motion, is projected upon a transparent screen, the latter preferably erected vertically. This screen is made of ground glass, or other translucent substance. At the opposite end of the transparency and spaced a suitable distance therefrom, a dodecagonal mirror is mounted horizontally upon a suitable standard. This mirror-prism is rotated by means of an electric motor geared to the shaft of the mirror. Between the prism and the transparency, a screen is mounted in such a position that it will not intercept rays of light from the transparency to the mirror but will intercept those extraneous rays reflected from the mirrors in the direction of a bank of selenium cells. This screen has a very narrow slot in it, approximately ¼ inch wide, through which narrow bands of light of the transparency reflected from the mirror can pass to this bank of simply constructed selenium cells, or other light responsive devices.

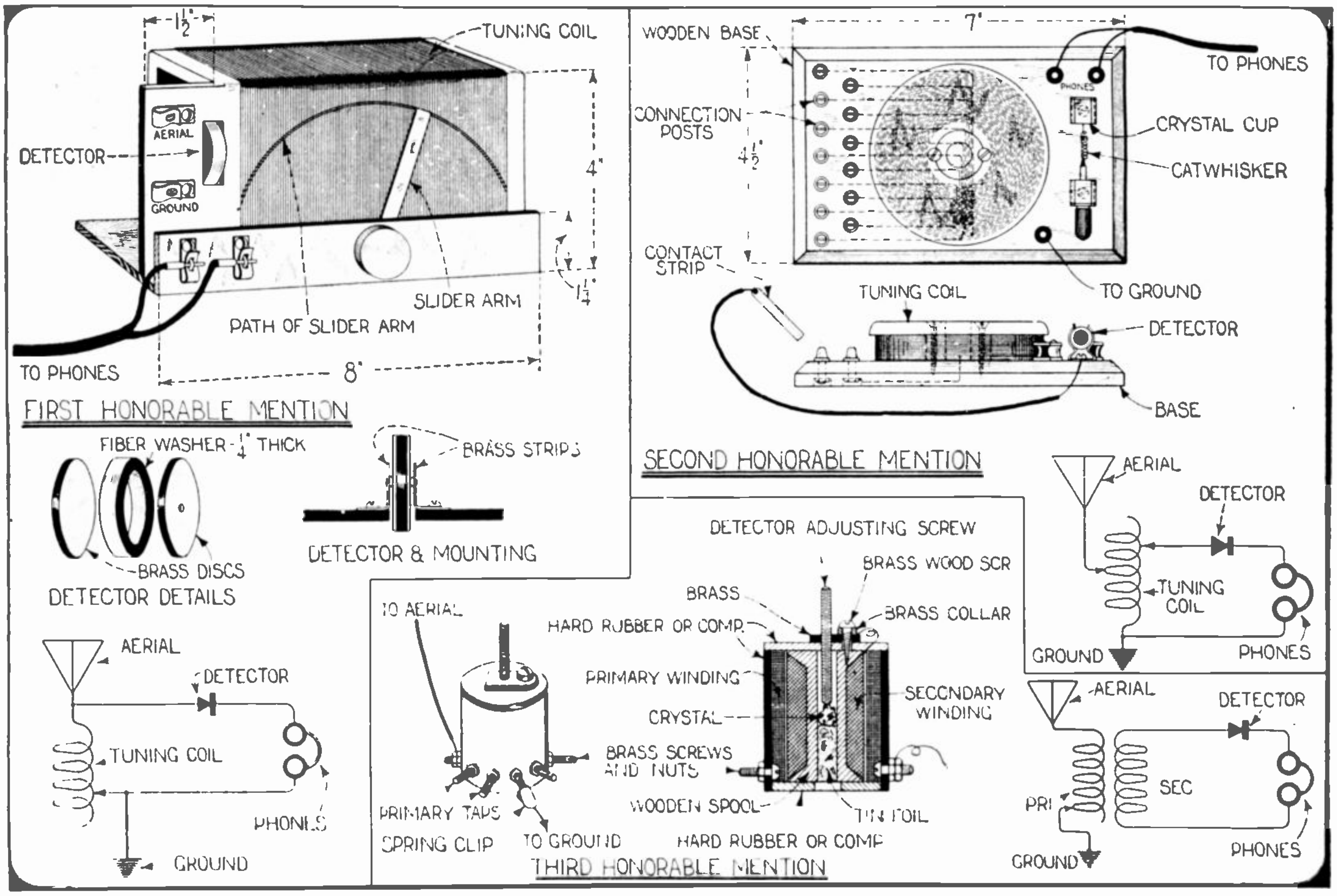
In Fig. 2 a simple selenium cell is shown. This consists of a block of insulating material, coated on one face with selenium after two bare copper wires, separated a fraction of an inch from each other, have been wound upon the same. It will be noted that the rays of light directed upon the transparency are in turn reflected from the rotating mirror to the opaque screen, where a few of them passing through a slit strike the selenium cell, and due to the peculiar action of this cell permit a greater or less amount of current to pass from one of the conductors wound around the insulated rod to the other, the amount of current varying with the strength of the light rays falling upon the device. The operation of the sending instrument is as follows:

We will assume that a picture is being projected upon the transparency through the lens. The mirror prism is rotated so as to produce a rapid progression of its faces before the screen. Thus with the dodecagonal prism, as illustrated in our sketch, the prism may be rotated at the rate of 100 revolutions per minute, as a result of which 1,200 mirror faces will be presented before the transparency per minute. If the mirror rotates in the direction of the arrow, it will be seen that the mirror faces opposite the

(*Continued on page 1028*)



One of the simplest methods of transmitting pictures via radio is shown in the illustration above. The revolving mirror produces the continuity of the picture so much desired, and only one single row of selenium cells in the transmitter, or mirrors in the receiver is required. The circuit diagrams for both the transmitting and receiving station are shown. A vacuum tube with a supplementary grid is employed in both circuits.



The three final entries awarded "honorable mention" degrees in our $300.00 "Simplest Radiophone Receiver Contest," held some months ago, are illustrated and described herewith. The third honorable mention goes to Miss Elizabeth C. King, one of the few lady contestants in the contest.

Honorable Mention Awards in the $300.00 Simplest Radiophone Receiver Contest

FIRST HONORABLE MENTION TO KENNETH M. WHITE.

THE tuning coil used in connection with this set is wound on a square form 4 inches on a side. To make this form, obtain four pieces of ½ inch wood, three of them 6½ inches long and one of them 8 inches long. Nail them securely together, and wind thereon 300 turns of No. 28 SCC magnet wire. The winding must be made evenly, especially on the front, where the slider is to run. The winding should be started one-half inch from the right hand end of the coil, and should proceed to within one-half inch of the other end of the short sides.

In the extending end of the front board, a slot must be cut to allow a detector to protrude through. Two clips made of spring brass are also mounted as shown. A dent should be made in each strip to grip the detector unit described below.

The detector used in connection with this set is unique, in that it does not employ a cat-whisker for contact with the crystal. It is composed of two copper discs as shown in the drawing, about one inch in diameter, and a fibre or hard rubber washer, with the same outside diameter, and an inside diameter of about one-half inch. This washer should be at least one-fourth of an inch thick. With a very small quantity of shellac, fasten the washer to one of the copper discs and drop into the hole several pieces of crushed galena and some brass and nickel filings. With a little shellac fasten on the other copper disc and bind the whole together with a strip of adhesive tape, being careful to leave a bare space in the center of each copper disc. This is done so as to make contact with the supporting strips.

The entire outfit is mounted on a base which has a narrow panel in front for mounting the switch arm and phone clips. After the switch arm is mounted as shown in the illustration, the insulation is scraped off the wire in a path upon which the end of the switch is to travel. The instruments are connected together as shown.

To adjust the detector, put the phones on, and turn the projecting part of the detector disc slightly with the thumb until the signals are heard. It would be to advantage to use a buzzer test, so as to tell when the detector is in perfect adjustment.

With this set and a single wire aerial 75 feet long, the writer was able to tune in Arlington time signals, as well as amateur, government and commercial stations, and the radiophone broadcasting stations. The set was found to be very selective even without the use of variable and fixed condensers.

Second Honorable Mention to E. A. Jozwick

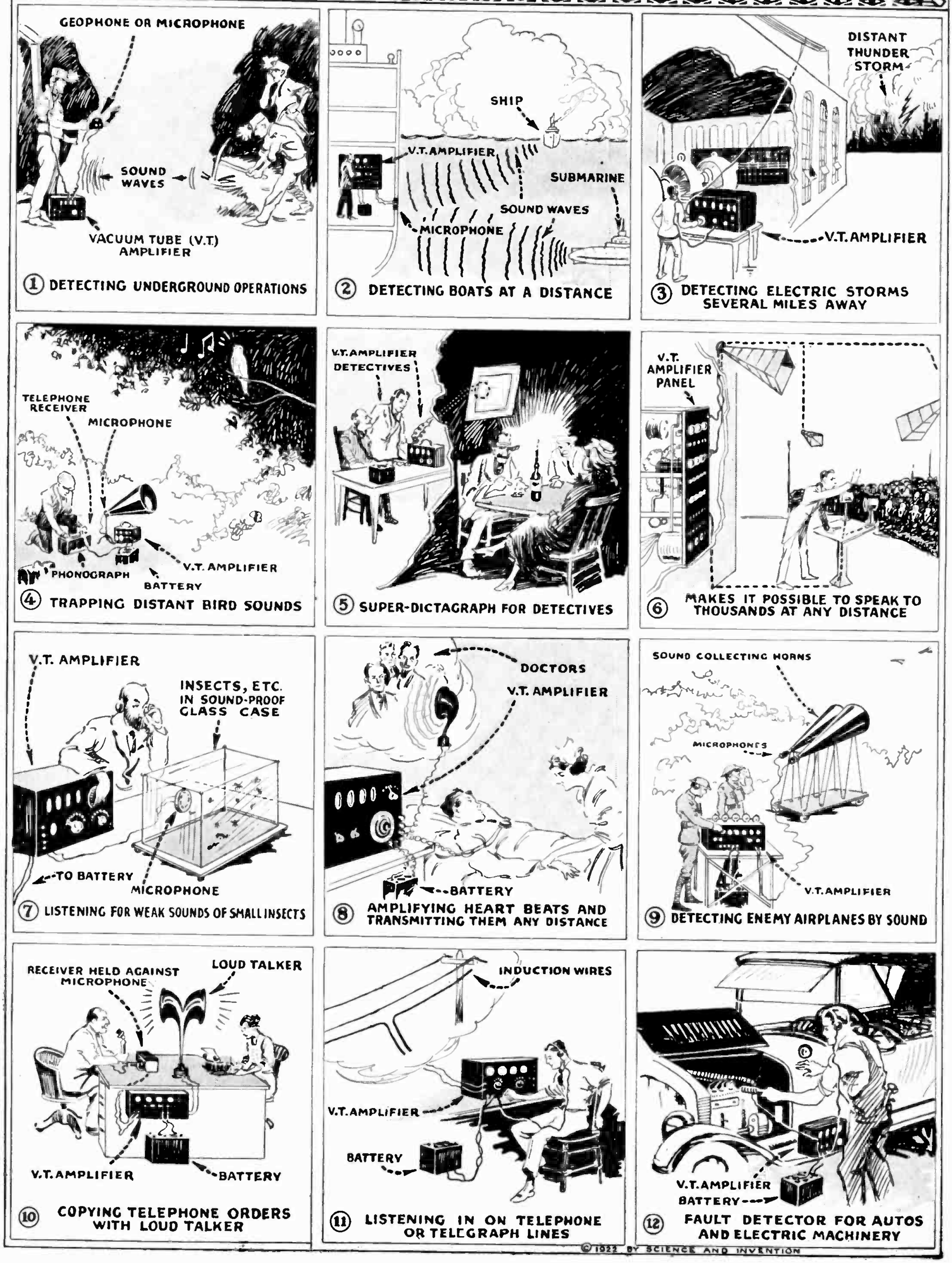
This set, which is mounted on a wooden base, 7 inches long by 4½ inches wide, may be very easily made from odd parts found around the house.

First obtain the base which is made of ⅝ inch hard wood, and also a disc 3½ inches in diameter. In the center of this disc bore a hole 1 inch in diameter, and insert therein a piece of 1 inch dowel, 1 inch long. This is fastened to the base as shown in the illustration. On one side of the base about ½ inch from the edges and directly under the wooden disc, drill 13 small holes, the arrangement of the same being practically immaterial. On one end of the base drill 13 more holes for connecting posts as shown. From the first 13 holes, carve small grooves in the bottom of the base to the connection posts in which to lay the wire leads. Now commence winding the coil, connecting the end of the wire to post No. 1. Wind 15 turns and take off a tap to post No. 2. Proceed in this manner until 13 taps are made.

The connection posts are obtained from old dry cells. These can be obtained for nothing from any electrical supply store or telephone company central office. When these cells are obtained, it will be found that there is a binding post connected to the zinc of each one. By applying heat to the base of these binding posts with a gas burner, blow torch or soldering iron, they may be lifted off and it will be found that there is a slot in the base of each one. This slot is used in making the connections in this set. After all the taps are soldered to these connection posts, obtain an old fuse block and a fuse to fit the same. Remove the clips from the block and mount them on the opposite end of the base as shown. Remove the fibre tube from the fuse, and in one of the brass cups mount a piece of galena with soft metal. Drill a hole in the end of the other cup, and insert a brass bolt to one end of which is fastened a hard rubber handle. To the other

(Continued on page 1023)

Uses for Audion Amplifiers



① DETECTING UNDERGROUND OPERATIONS

② DETECTING BOATS AT A DISTANCE

③ DETECTING ELECTRIC STORMS SEVERAL MILES AWAY

④ TRAPPING DISTANT BIRD SOUNDS

⑤ SUPER-DICTAGRAPH FOR DETECTIVES

⑥ MAKES IT POSSIBLE TO SPEAK TO THOUSANDS AT ANY DISTANCE

⑦ LISTENING FOR WEAK SOUNDS OF SMALL INSECTS

⑧ AMPLIFYING HEART BEATS AND TRANSMITTING THEM ANY DISTANCE

⑨ DETECTING ENEMY AIRPLANES BY SOUND

⑩ COPYING TELEPHONE ORDERS WITH LOUD TALKER

⑪ LISTENING IN ON TELEPHONE OR TELEGRAPH LINES

⑫ FAULT DETECTOR FOR AUTOS AND ELECTRIC MACHINERY

New and Odd Uses for Audion Amplifiers

By H. WINFIELD SECOR

THE vacuum tube or audion amplifier has, in the past few years, been adapted to many new and novel requirements in applied science. A great deal of the research work performed in adapting the vacuum tube amplifier to every-day science problems was speeded up by the advent of the World War. Thanks to the marvelous audion with its untold possibilities, the voices in enemy trenches or the telephone currents passing over their wires 75 to 100 feet away and more, were readily intercepted and valuable military information gathered in this way. Submarines, sneaking along under water, were detected and frequently located and bombed from the air, or by means of depth bombs. Thanks to the super-sensitive microphone submerged in the water at the stern of the vessel, the sound of the submarine's engines and propeller were communicated to the microphones by sound conduction through the water, and the microphone current pulsations were afterward amplified with a vacuum tube amplifier.

Referring to our illustration herewith, and taking up the several uses of the V. T. amplifier in the order we have here arranged them, we see in Fig. 1 a valuable use for this amplifier in intensifying the sounds transmitted through the earth by entrapped miners in coal or metal mines. The geophone will detect the human voice as well as the sound of tools striking coal or ore, at a distance of 100 feet or more, and where the distance is greater, an audion amplifier microphone may be used in connection with the geophone, or else the microphone itself may serve as the sound detector. The sound waves are transmitted by the earth, coal and ore, and these vibrations are communicated to the diaphragm of the microphone, etc., in the well-known manner. By using several stages of audion amplification connected with the microphone, faint sounds over medium distances may be easily heard, or stronger sounds may be heard over a proportionately greater distances than where the V. T. amplifier is not used.

As Fig. 2 shows, not only submarines, but other warships or steamships can be heard when several miles away, due to the vibration of their engines or propellers, the sound of which is transmitted through sea water at a velocity about four times greater than that through air. The conduction of the sound through water is also much more efficient, as it acts more or less like a solid conducting body. There are several different systems in use and which were devised during the World War, whereby various styles of microphones or listening devices with diaphragms both large and small, are mounted in a hole cut in the steel hull of a vessel, or else supported against the hull of the vessel on the water. The sound waves as they traverse the water finally impinge against the diaphragm, and the microphone or other apparatus serves to modulate the electric current passing through its circuit, which can be amplified by a V. T. amplifier to any degree desired. Of course there is a limit to the amount of amplification which is practicable in such cases, as when you get too high an amplification, such as eight or ten stages, the apparatus becomes supersensitive, and like many other scientific devices, it defeats its own purpose by being, as we might say, too efficient. It is then liable to pick up many unwanted noises and be so sensitive to adjust that such adjustment could only be accomplished with considerable difficulty. During the War the radio operators used to tell a good joke about a seventeen-step British audion amplifier, which permitted the British commander of the "grand" fleet to lay off the English coast and hear the German sailors goose-stepping over the decks of the Kriegschiffe off Heligoland. A four or five stage amplifier will usually give all of the amplification that can be properly handled.

The audion amplifier has increased the daylight range of long-distance radio stations several fold, as signals which are too weak to operate the detector can be amplified with a radio-frequency V. T. amplifier, and then passed through a V. T. or other detector. By erecting an aerial on a powerhouse or sub-station, and using a V. T. detector and amplifier on several stages, it becomes possible to detect the approach of an electric storm several miles away, so that extra boilers may be started and arrangements made to take care of the great draughts on electric power, demanded when the storm arrives and people begin to switch on the lights.

A novel and valuable use for a V. T. amplifier lies in the trapping of distant or faint bird music. Students of bird life find a V. T. amplifier, even if of small size, invaluable in amplifying the golden notes of our feathered friends, as it is frequently quite difficult to get very close to them.

The super-dictagraph for detectives or for deaf people is shown in Fig. 5. This machine is now available in the commercial market, and sells for less than one hundred dollars. This V. T. amplifier dictagraph will pick up whispers at a distance of 35 to 40 feet, and normal voice sounds at a distance as great as 75 feet It is small and compact, and can readily be carried anywhere.

Persons with weak voices or even those with extra strong voices find themselves at times greatly handicapped in trying to speak to a large crowd of people. Thanks to the audion amplifier, it is possible today for a speaker with an ordinary voice to speak to thousands of people easily without extra exertion or straining his throat. In front of the speaker are placed one or more sensitive microphones of special construction, and wires from these lead to a multiple stage audion amplifier. Extra large loud-talkers connected to the audion amplifier thus cause the speaker's words to be intensified and distributed over a large area.

Thanks to the V. T. amplifier, we shall no doubt very shortly know a great deal more concerning the insect world than we do at present. There are myriads of sounds given forth by the insect world, of which we as yet know nothing. Fig. 7 shows how an investigator may place the insects to be studied in a sound-proof glass case, fitted with a sensitive microphone, and with the help of the amplifier and a pair of phones, will be enabled to intensify the very weak sounds given forth by some insects, which may be inaudible to the human ear.

Figure 8 shows the amplification of heart-beats by means of an audion amplifier, and this achievement was carried out some time ago in Washington by General Squier, Chief Signal Officer of the U. S. Army. With a four to six stage V. T. amplifier, and a good loud-talker, the heart-beats of a patient as he lay in a hospital bed, were amplified and listened to by a group of physicians in a room in another part of the building. It is interesting to note that for special cases, the microphone currents can be amplified and transmitted over a telephone circuit for practically any distance, even across the United States, and diagnosed by a specialist. Suppose you were ill in San Francisco, and you desired a New York specialist whom you knew or had heard of, to diagnose your trouble. It is now possible—indeed it has already been done—thanks to the audion amplifier, to let the physician hear your actual heart-beats and respiration sounds, several thousand miles away, just as if he were beside your sick bed.

The illustration at Fig. 9 shows enemy aircraft detected by a combination of large sound-gathering horns, fitted with sensitive microphones and a vacuum tube amplifier. The amplifier intensifies the sound wave current passing through the microphone circuit, while the receivers worn by the listener are connected to the output circuit of the amplifier.

In Fig. 10 is shown a commercial application of the V. T. amplifier to the ordinary telephone, which is being used by one of the large corporations in New York City, for the purpose of having the stenographer take down the customer's verbal orders for goods as they come in over the telephone. The V. T. amplifier and loud-talker are connected with the receiver of the telephone which the salesman is using, and when the customer is about to specify the goods he wants shipped, he places the telephone receiver in a spring clip secured to a small box standing on his desk, inside of which there is a sensitive microphone. This microphone is connected with the input side of the V. T. amplifier through a modulation transformer of as high a ratio as possible. The loud-talker is, of course, connected to the output terminals of the V. T. amplifier, and by arranging a special horn with two openings to it, as shown in the picture, the salesman, as well as the stenographer can hear the amplified voice of the customer.

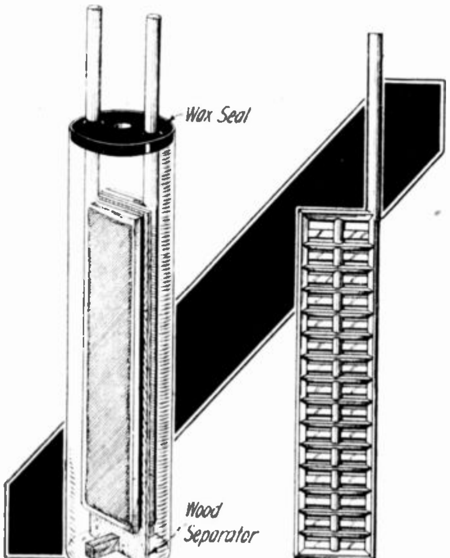
The diagram shown at Fig. 11 illustrates how telegraph or telephone messages may be intercepted or overheard by induction between the line wires and a second circuit placed in more or less close proximity to the circuit over which they are passing. During the World War this was a very common performance, especially in the front line trenches and many an Allied or German message of importance being transmitted by telephone or telegraph was intercepted and made good (or bad) use of. In some cases, the listening circuit was 30 to 40 feet or more from the circuit or the line wires over which the telephone or telegraph message was passing. Of course the greater this distance, the more amplification we need. The wires running parallel with the circuit to be listened-in on, need not be very long, but the longer, of course, the better.

There are many other uses for audion amplifiers, which we have not the space to describe here, and some of these we have

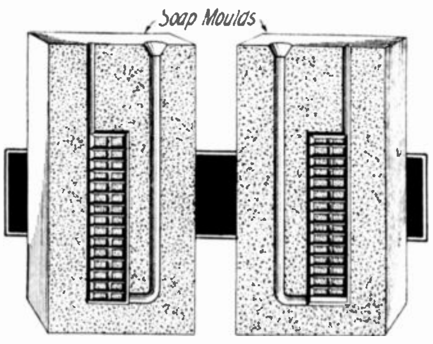
(Continued on page 1029)

Storage "B" Batteries

HAVING first procured an unpasted plate or grid of a farm light storage cell from a friend, I cut out a section about ⅞" wide and 4" long, leaving the up and down cross-sections on each side. This was used for a pattern. A piece of soap stone was employed as a mould. A piece of this about 2½" wide and about 7" long, and 1½" thick, was sawed in half, and each side was made smooth, so that both fitted together very closely. I then took the pattern and scribed the lines on the smooth faces of both stones, following the general measurements of the pattern. A triangular



Above is a diagram of the storage "B" battery, reproduced from the actual model forwarded by the author, and to the right of this, the finished grid as it appears before it is pasted.

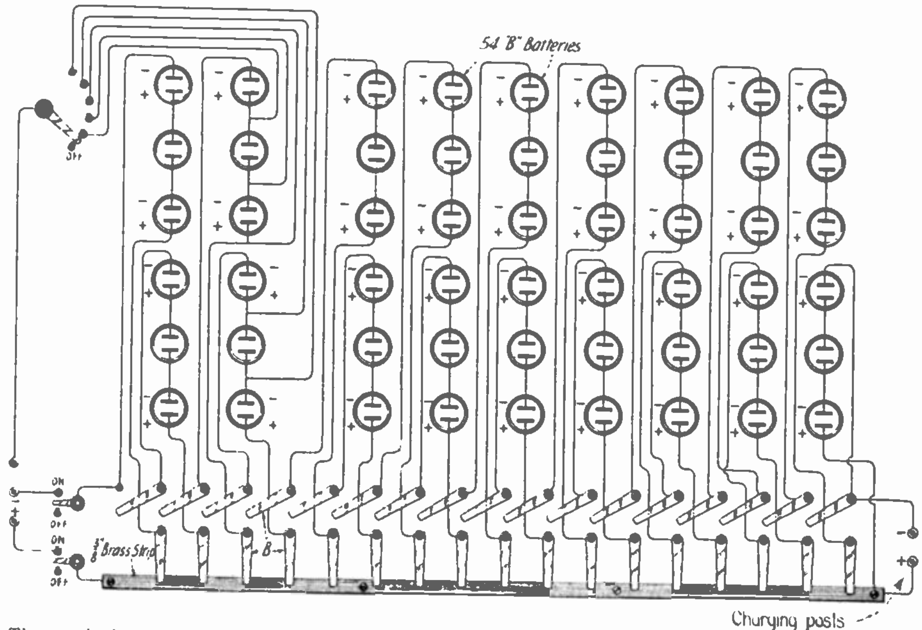


The mold above is made of soap or sandstone, the two halves are joined and the grids made by pouring molten lead into this form.

or three-cornered file with a handle had its end ground to a bevel. This was used to dig out the mold after the preliminary scribing operations had been completed. When the mold was cut deep enough, the pattern was put in place. The two stones should now fit together closely with the pattern between them. Putting a pair of small brass hinges at the edges of the stone, I fastened them in place by drilling and tapping holes to take 6-32" machine screws. The stones were now coated with a heavy insulating varnish, and a catch put on the front to hold them shut, drilling and tapping as before. Closing the mould, a ¼" hole was drilled down from the top for pouring the lead. This also gave me a lead on my plate or grid.

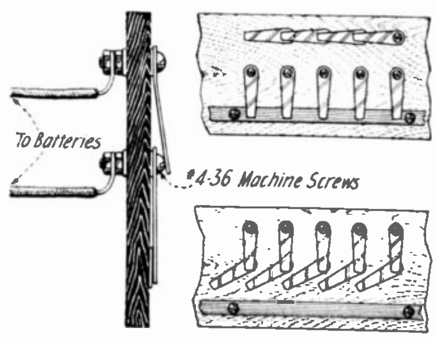
From a friend who worked in a large dairy, I obtained some test bottles that are used for testing milk. These measure 1⅛" inside diameter, and are about 5" long, made of heavy glass with flat bottoms. Ordinary wood partition as used in boxes for packing bottles for shipping purposes, was employed in making separators and plate-rests. Before use the separators were boiled in paraffin. Purchasing some electrolyte, red lead and litharge and pasting the plates, I took some cardboard which was paraffined and cut out several circles to fit in the top of the cells. Three holes were then cut in the cardboard circles, as shown in the sketch, two outer holes being for the plate leads, and the center hole being for a vent. On the center hole a piece of small rubber tubing was secured, as shown in the sketch. Then putting some insulating compound on the under side of the cardboard circles, the plates and separators were assembled, and cardboard covers put on, and pushed down to about ⅛" or 3/16" below the top of the jar. This ⅛" space was then filled with insulating compound, the small piece of rubber tubing preventing the compound from running into the center hole or vent. After filling the cells with electrolyte, the same were ready to be wired, soldered together and charged.

The switching arrangement shown proved very satisfactory, but a four one quart jar electrolytic rectifier did not give me the results desired. I then decided to charge the same from my 6-volt generator, so I employed this multiple, 8 series switch. By



The particular arrangement of the switches shown is neither for parallel or series. The brass strip and the individual switches, as well as their respective mountings and the connections for the 54 "B" batteries, are given in the above diagram. Note how the voltage for the detector tube can be varied by a switch provided for that purpose.

charging all the cells, (54), at 6 volts on a 4 ampere rate for twenty-five minutes, and then putting the 54 cells in series, and discharging them for about fifteen minutes with a 110-volt, 10 watt lamp, and then recharging again, I was able to use the battery on a 2 step amplifier set. After three days usage these cells showed 6½ volts to each



The uppermost illustration shows a multiple connection used with the "B" batteries for charging the same from a 6-volt rectifier, and below the method of arranging the switches so that the entire group of "B" batteries will be placed in series. The diagram at the left illustrates the manner in which the switches are made and how they are wired together. Note the bus-bar at the bottom of this diagram.

of the three-cell groups. A rack was then built as illustrated. The entire battery cost but five dollars.

Contributed by JOHN M. DODENDORF.

Brass Etching

For etching on brass a satisfactory *ground* or *resist* may be made from equal parts of beeswax, Burgundy pitch, and asphaltum, melted together and thoroughly stirred in order to secure a uniform mixture. This *ground* is warmed before application and spread evenly over the surface to be etched. When cool, the *resist* is removed from those parts of the metal that are to be etched, and the etching fluid is applied. A satisfactory etcing fluid consists of one part of nitric acid to four parts of water. The etching will be completed in a few minutes, after which the work is dipped in hot water to wash off the acid. The surface of the work is cleaned off by wiping it with a cloth dipped in benzine or gasoline.

For etching steel, the same kind of ground as used for brass is employed. The etching solution consists of four ounces of pyroligneous acid (wood vinegar), one ounce of alcohol, and one ounce of nitric acid. The work is washed in hot water and cleaned with gasoline or benzine, as previously described. The work should be perfectly clean before the ground is applied.

Contributed by F. H. SWEET.

NOVEL "BASKET WEAVE" WINDINGS

As almost every one in radio is acquainted with the so-called basket-weave inductances for tuning transformers, and know of their merits in regenerative circuits, an idea is herewith presented in brief and the builder

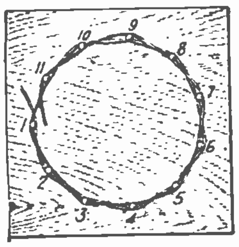


Fig. 1

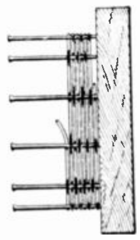


Fig. 2

Above is a front and side view showing the construction of basket-weave tuning coils.

may choose his own materials and methods in construction.

We need not go into detail of the winding, as the principle is universal and has been published heretofore, the secret, of course, being to have an odd number of pegs, 7, 11, 13, etc., Fig. 1. The wire is started alternating around each peg and in so doing, each turn cuts its adjacent, the effect being small capacity and large inductance. The builder may suit himself in using pegs, matches being commonly employed and left in the finished coils. The size and number of wire turns, etc., will depend on the builder's specifications. A wooden base is used and the coils are woven in cylindrical form, Fig. 1.

Fig. 2 shows the partially finished coil. When the desired size is woven, the pegs are loosened from the base, the weave removed, and bathed in hot paraffin or shellac. Cardboard tubing may be inserted on the inside for reinforcement. Fig. 3 shows the finished coil. Fig. 4 shows the secondary coil completed, with pivots, knob and connections to each pivot (A).

The primary coil is wound similarly, being ¼ to ½ inch or so larger in diameter. Fig. 5 shows the principle of the instrument with its revolving secondary (E) and the stationary primary. A bearing of wood or rubber is mounted on the side of the primary (B) and brush contacts (C) are made for the secondary. The primary coil may be mounted on a panel by means of a strap (D).

This style of coupler or variometer may be used in either crystal or vacuum tube work, the number of coils and turns being fixed by the amateur's resources and type of circuit. For longer wave ranges the coils should be tapped. By a change in connection the coils become either vario-couplers or vario-meters.

Contributed by C. O. WALTERS.

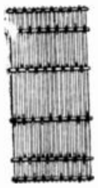


Fig. 3

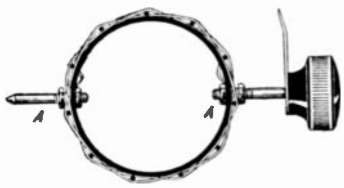


Fig. 4

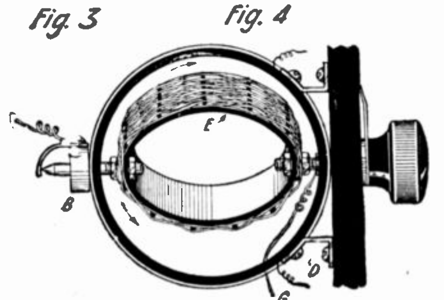


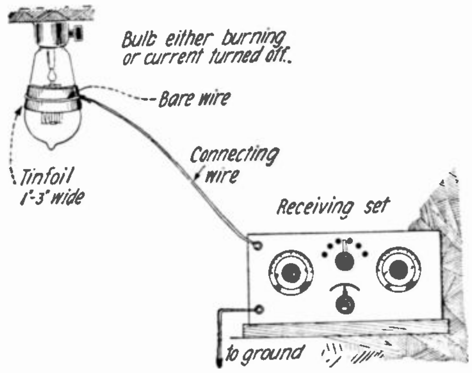
Fig. 5

The basket-wound coils as described in the article above, make very fine variometers and vario-couplers when mounted as shown here.

UNIQUE INDOOR AERIAL

Does your landlord object to your constructing an aerial? If so, the following simple system will be found very effective. As a matter of fact the writer has used the same on a little crystal set in his home very successfully. A piece of tinfoil is first fastened around an incandescent bulb, and then some bare wire is wound around the tinfoil, so as to hold it in place and to make connection to the outfit. The other end of this wire is connected to the aerial binding post of the panel. The bulb is now screwed into the lamp socket and the "aerial" is ready for use. It will work whether the lamp is turned on or off. The usual ground connection is of course made. If no tinfoil is at hand, wrapping the wire around the lamp socket several times will answer. The tuning of the set will be different than if an outdoor antenna is used.

Contributed by RUDOLF F. KAHN.



The aerial here shown was found to be almost as effective as a condenser placed in series with the lighting circuit.

USES FOR BRASS CHAINS

Here are a few uses for brass chain, such as is commonly used as dog or key-ring chain.

Fig. 1. A single link held under a binding post to hold large wire W, or several small wires.

Fig. 2. A single link to join several wires without soldering, or to act as a tap of a large wire W.

Fig. 3. A single link to support insulated wire W.

Fig. 4. A small spade tip for wires made by cutting a flattened link on the dotted line, binding the wire to the straight part with finer wire, and soldering.

Fig. 5. An efficient ground clamp, which will hold large wire W, or small wire under the nut.

Fig. 6. A flexible cable for heavy currents consisting of chain covered with rubber tube.

Fig. 7. A handy fastener for small tubing or wire made of a single link bent as shown, and fastened with tacks or screws.

Contributed by LOUIS SLIVAN.

HOW TO MOUNT A DIRECTIONAL LOOP AERIAL

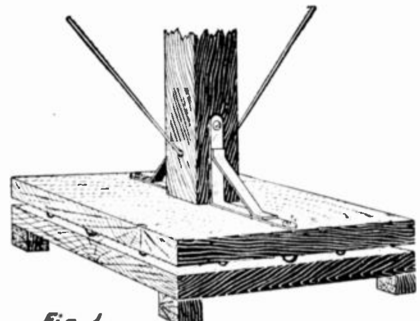


Fig. 1

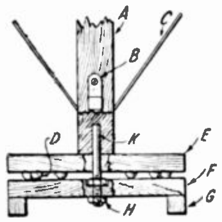


Fig. 2

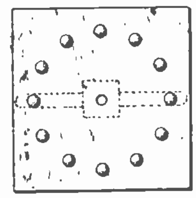


Fig. 3

A unique method of mounting a loop aerial, so that it is steady yet at the same time may be freely rotated, is shown in the diagram here given.

All the material necessary is one dozen nickel-plated chair leg knobs which can be purchased in any hardware store for 24 cents and 2 ordinary shelf brackets—2 for 5 cents. All other things that are used can be found in any home.

Any kind of a loop, or any type of winding can be employed, the amateur usually preferring his own style. I will therefore deal solely with the construction of the mounting. The exact measurements are shown in the illustration.

The base, Fig. 2, is constructed of ¾-inch pine 10 inches square. Legs 1 by 1 by ¾ of an inch are attached to the corners to allow for variation of the length of the bolt. A ⅜-inch hole is drilled in the exact center of the base.

The turntable, Fig. 3, is the same size as the base. Find the exact center and draw a circle with a radius of 4 inches. Fasten the knobs at equal distances on this circle. Now bore another ⅜-inch hole in the center of the turntable.

Fasten the shelf brackets on opposite sides of the support A. Drill another ⅜-inch hole, K, in the end of the support deep enough to afford ample support for the frame, yet avoiding the hole for the outside wire of the loop, J. It must be understood that the loop is not depending upon the bolt for its support. Now pass the bolt through the base, turntable and the hole in the end of the support and adjust the nut so that the turntable knobs sit flush with the base.

Contributed by C. F. BOHLIG.

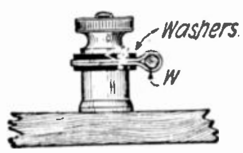


Fig. 1

Fig. 2

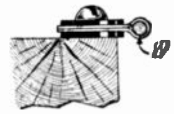


Fig. 3

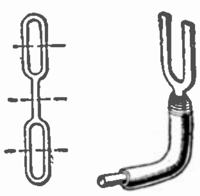


Fig. 4

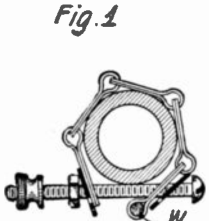


Fig. 5

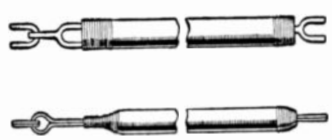


Fig. 6

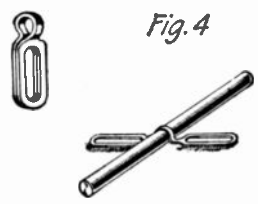
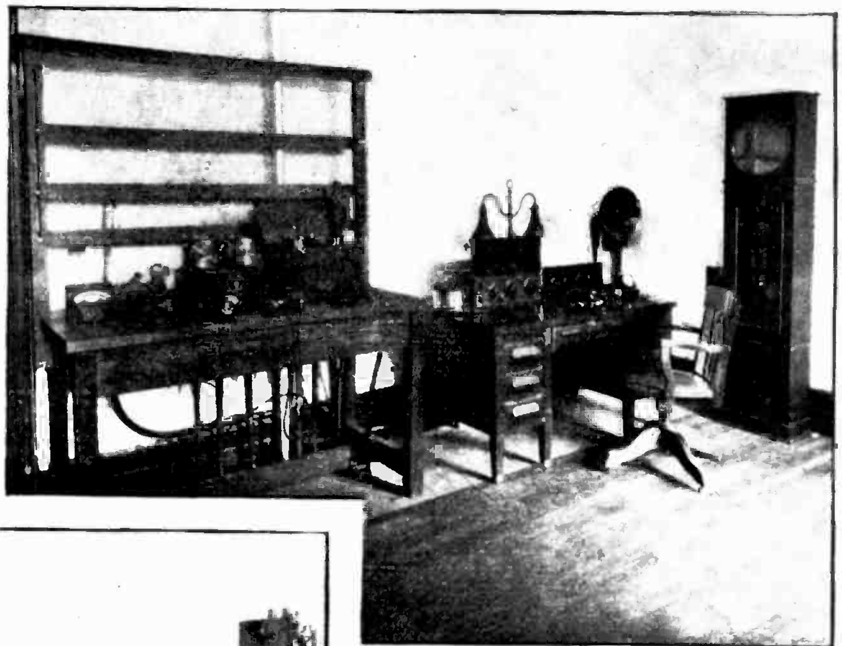


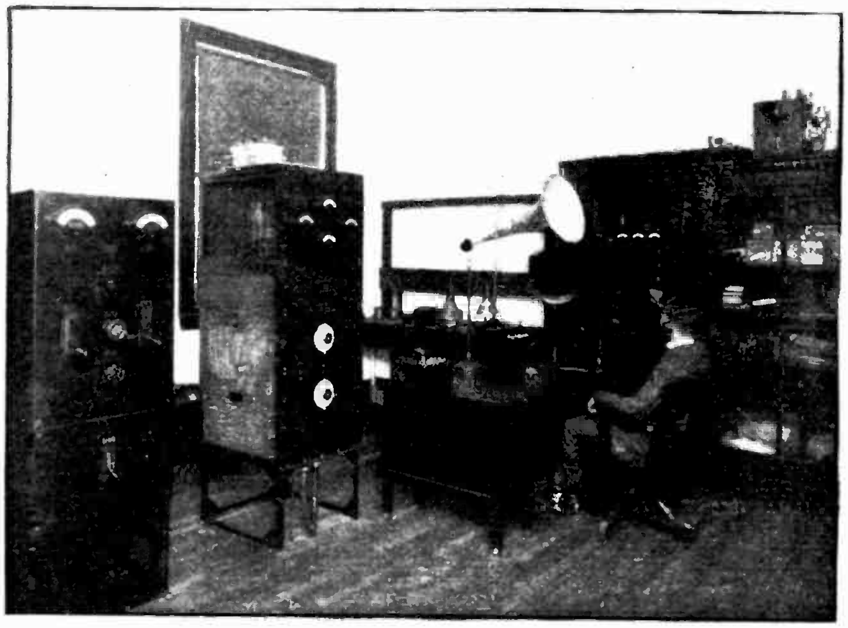
Fig. 7

A brass chain may be put to many uses by the average experimenter. The links of the same can be employed individually or collectively as lugs, wire clamps, tips for telephone cords, ground clamps, straps for securing wire to woodwork, and flexible cables for conducting heavy currents.

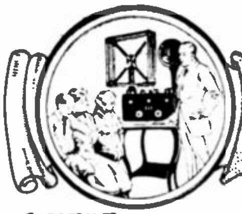
BROADCAST STATIONS

At the right and below are views of the operating room of "WHAZ," the broadcasting station of the Rensselaer Polytechnic Institute, of Troy, N. Y. The station is fully equipped and broadcasts every Monday from 8:15 to 9:30 P. M. Specially adjustable apparatus is used in the transmitter to reduce distortion to a minimum, and the resulting tones are very pleasing. Besides a very complete receiving set, this station employs two Poulsen telegraphones, by means of which speech and music may be received from a distant transmitting station, and re-transmitted at will. Their consistent range is 1,800 miles





Below at the left is shown the switch-board and power tubes of station "CFCA," owned by the *Toronto Star*, of Toronto, Canada, and the operator, E. J. Bowers. The normal radiation of the transmitter is 6 amperes. Below is shown the "Radio Car," also owned by the "*Star*."



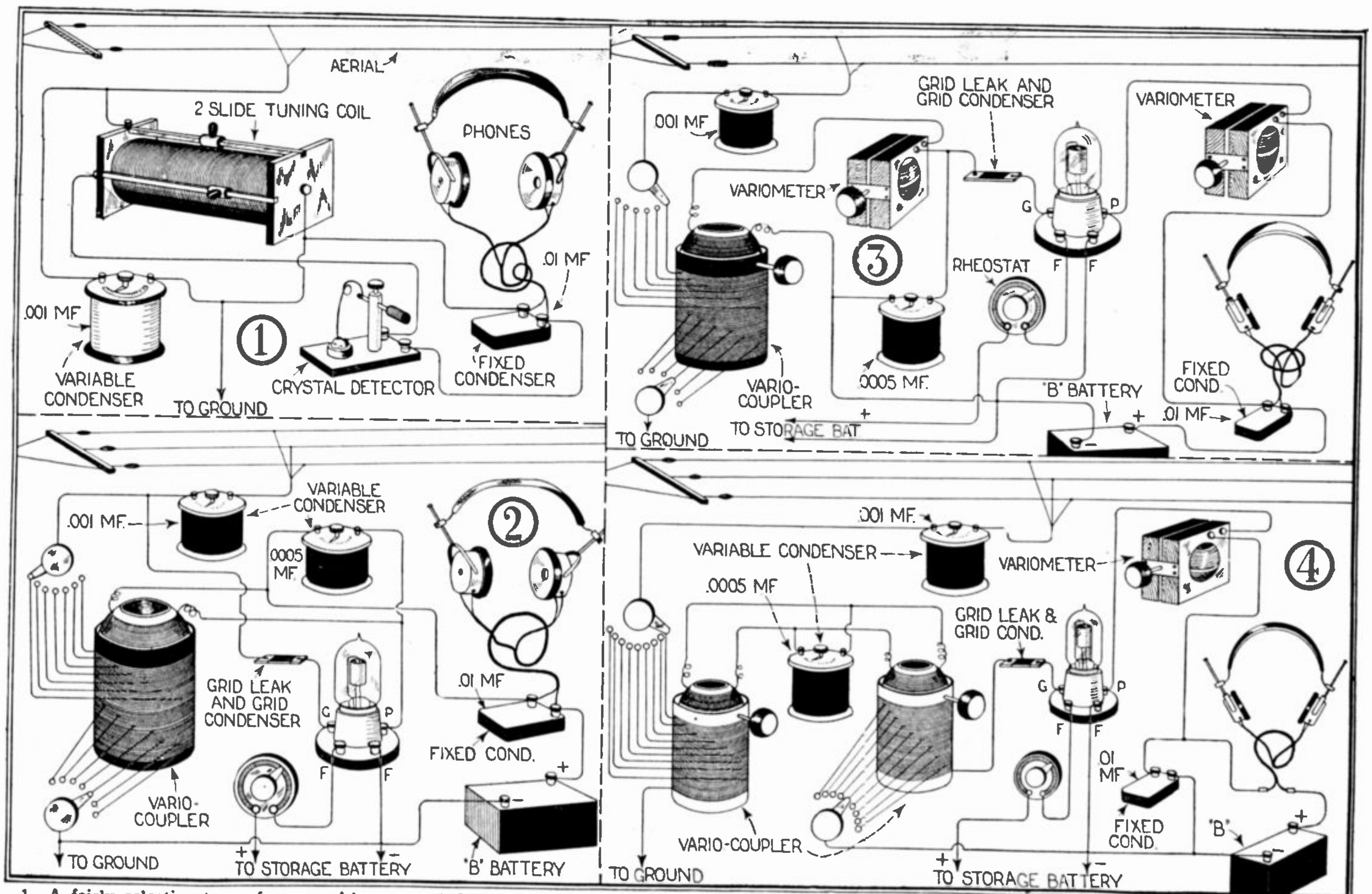
RADIO BROADCAST

THERE are so many broadcasting stations which have forwarded information, that we regret we have only space enough to print a very few. Those stations which have been courteous enough to submit photographs will find that the photos will be published in due time. The stations listed on this sheet will not be published in the next issue. We would suggest to our readers that the map locations indicated on this page are for the special supplement map given free with the May issue of SCIENCE AND INVENTION. At a great expense this list of the stations has been practically completed as far as commercial broadcasting stations are concerned. We will present our readers with additional information on the new stations as it is brought to our attention. Address all communications to Editor Radio Broadcast, c/o SCIENCE AND INVENTION MAGAZINE, New York City.

ELABORATED LIST GIVING TIME AND NATURE OF BROADCAST (Continued from previous issues)

Call Letter	Name	City	State	Wave Length
WIAK	Daily Journal-Stockman. Weather, market reports daily except Saturday, and Sundays, 7.45 A. M., 9.10 A. M., 10.15 A. M., 12.00 M., 1.50 P. M., 3.50 P. M. Saturdays 7.45 A. M., 9.10 A. M., 10.15 A. M., 12.00 M. Central time. Consistent range 200 miles, maximum 500.	Omaha,	Nebr.	360 485
WIAN	Chronicle & News. Lectures, vocal and instrumental talent, baseball scores and special features Wednesdays 8.00-9.00 P. M. Eastern standard time. Consistent range 60 miles, maximum 200.	Allentown,	Pa.	360
WJAE	Texas Radio Syndicate. Weather, market reports, vocal and instrumental talent, baseball scores, news bulletins and special features daily except Tuesdays and Saturdays 7.30-8.30. Tuesdays 8.30-9.30 P. M. Sundays 6.00-7.30 P. M. Consistent range 200 miles, maximum 1,000.	San Antonio,	Tex.	360
WJAF	Muncie Press-Smith Electric. Weather, lectures, market reports, market reports, vocal and instrumental talent, baseball scores, and news bulletins daily except Sundays 3.30-4.00 P. M. Mondays, Wednesdays, and Fridays 7.00-8.00 P. M. Saturdays 6.00-7.00 P. M. Consistent range 400 miles, maximum 1,500.	Muncie,	Ind.	360
WJAG	Norfolk Daily News. Weather, lectures, market reports, sermons, vocal and instrumental talent, baseball scores, news bulletins and special features, daily except Sunday, 12.15 M., 3.30 P. M., 5.30 P. M. Thursdays 9.30 P. M. Sundays 7.00 P. M. Consistent range 150 miles, maximum 700.	Norfolk,	Nebr.	360
WJAG	Electric Equipment Co. Weather, lectures, market reports, music, sermons, baseball scores and specal features Mondays and Fridays 9.00-9.30 P. M. Sundays 7.40 P. M. Consistent range 200 miles, maximum 600.	Erie,	Pa.	360
WJZ	Westinghouse Electric & Mfg. Co. Daily 9.00-9.15 A. M., market reports; 11.55-1.00 P. M., time signals and music; 4.00-4.15 P. M., closing stock quotations and music; 5.30-5.45 P. M., closing stock and bond, grain and market reports; 5.45-6.00 P. M., sporting events; 7.00-8.00 P. M., bedtime stories; 8.00-9.55 P. M., elaborate programme of plays, lectures, dance music, operas, etc.; 9.55-10.01 P. M., time signals and weather forecast; 10.01-10.30 P. M., continuation of the programme. Sundays 11.00 A. M. to 3.00 P. M., sacred music, sermons. Regular evening programme. Eastern standard time.	Newark,	N. J.	360
WKAA	H. F. Paap. Weather, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins daily 5.30 P. M., 6.00-7.00 P. M. Sundays 4.30 P. M. Consistent range 250 miles, maximum 350.	Cedar Rapids,	Iowa.	200-360
WLB	University of Minnesota. Weather, market reports daily except Sundays 12.00 M. and 7.30 P. M. Consistent range 100 miles, maximum 1,000.	Minneapolis,	Minn.	360-485
WLK	Hamilton Manufacturing Co. Weather, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily except Sundays 11.00-11.30 A. M., 12.00-12.30 P. M., 2.00-2.30 P. M., 3.00-3.30 P. M., 5.00-5.30 P. M. Tuesdays, Thursdays and Sundays 8.30-12.00 P. M. Sundays 2.30-4.00 P. M. Consistent range 200 miles, maximum 1,000	Indianapolis,	Ind.	360-485
WLW	Crosley Manufacturing Co. Weather, lectures, market reports, music, vocal and instrumental talent, baseball scores, news bulletins and special features daily except Sundays 10.00 A. M. to 3.30 P. M. Tuesdays, Thursdays and Fridays 8.00-9.00 P. M. Consistent range 1,500 miles, maximum 2,000	Cincinnati,	Ohio.	360 485
WMH	Precision Equipment Co. Weather, time signals, lectures, vocal and instrumental talent, baseball scores, news bulletins and special features daily except Sunday 11.00 A. M., 4.00 P. M. Mondays, Wednesdays and Saturdays 8.15 P. M. Consistent range 600 miles, maximum 1,100. Central standard time.	Cincinnati,	Ohio.	360 485
WNJ	Shotton Radio Mfg. Co., Inc. Lectures, market reports, vocal and instrumental talent. Mondays and Wednesdays 8.30-10.00 P. M. Tuesdays, Thursdays and Saturdays 10.30-10.15 A. M. Saturdays 8.00-10.00 P. M. Eastern standard time. Consistent range 60 miles, maximum 150.	Albany,	N. Y.	360
WOC	Palmer School of Chiropractics. Weather, time signals, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins, special features and police reports, daily except Sundays, 10.55-11.00 A. M., 12.00 M., 1.30 P. M. 3.30 P. M., 5.45 P. M., 6.30 P. M., and 7.30 P. M. Sundays 9.00 A. M., 12.30 P. M., 6.00 P. M., 6.30 P. M., 7.00 P. M. and 8.00 P. M. Central standard time. Consistent range 200 miles, maximum 1,800.	Davenport,	Iowa.	360-485
WOE	Buckeye Radio Service Co. Lectures, music, sermons, baseball scores, news bulletins and special features Mondays, Wednesdays and Fridays 7.00-8.15 P. M. Saturdays 4.00-4.30 P. M. Occasionally on Sundays 10.00-11.55 A. M. Consistent range 50 miles, maximum 500.	Akron,	Ohio	360
WOI	Iowa State College. Weather, time signals, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily except Sundays 9.30 A. M. and 12.45 P. M Consistent range 300 miles, maximum 1,200.	Ames,	Iowa	360-485
WOK	Arkansas Light & Power Co. Weather, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily 6.30-7.30 P. M. Tuesdays and Fridays 8.00-9.30 P. M. Sundays 11.00-12.00 M. and 7.45-9.00 P. M.	Pine Bluff,	Ark.	360
WOO	John Wanamaker. Weather, lectures, music, vocal and instrumental talent and sermons daily except Saturdays and Sundays, 11.00-1.00 P. M., 4.30-5.00 P. M. Mondays 7.00-11.00 P. M. Saturdays 7.30 P. M. Consistent range 800 miles maximum 2,000.	Philadelphia,	Pa.	360

(To be continued in the next issue—Save these as they will not be repeated.)



1—A fairly selective tuner for use with a crystal detector, is shown in Fig. 1. Greater selectivity is obtained by shunting the tuning coil with a 43 plate variable condenser. 2—A single circuit tuner hook-up, as shown in Fig. 2, will give fair selectivity, particularly if the two variable condensers shown, are used. A vernier will assist greatly if used in connection with the variable condenser shunted across the tickler. 3—To obtain greater selectivity than can be had from the set shown in Fig. 2, two variometers may be added, as shown in Fig. 3. The .0005 variable condenser is not absolutely necessary, but is advantageous for sharp tuning. 4—A super-selective tuner may be made by connecting two vario-couplers and a variometer, as shown in Fig. 4. This set allows the operator to tune out unwanted signals completely, and bring in those desired with a maximum volume.

Radio for the Beginner

By ARMSTRONG PERRY

No. 12--Selectivity

ONE of the first words a beginner hears, when he starts to shop around to find out how much of a set he can buy with his cash on hand, is Selectivity.

He may be attracted by the simplicity and price of a cabinet on which are only two or three knobs to adjust, and inquire if it will bring in the concerts and lectures from distant stations. He is told that it will, but that the cabinet with five or six knobs on it, which costs 50 to 100 per cent more, has greater selectivity.

If he is inquisitive, he asks why the more complicated tuner is better than the simpler one. The dealer explains that the simpler ones are single-circuit tuners and that a single-circuit, using fewer inductance coils, condensers and other parts than a two- or three-circuit tuner, cannot be tuned as sharply as the one using more parts.

Then perhaps the beginner decides to do some reading on the subject. If he chances to buy a copy of the official organ of the technical radio amateurs' organization he quickly discovers from the tenor of the intimate chat which it contains, that, if he uses a single-circuit tuner, he is unfit to associate with the radio elite; he is as unwelcome as a discharge of static; he has no right to call himself an amateur, though all dictionaries seem to grant him that privilege. Why?

There are two main reasons. First: The man who hangs out a sign "Everybody Welcome" is not popular with folks who crave exclusiveness. Second: A single-circuit tuner using electron tubes (any form of detector that lights up when in operation) transmits radio waves at the same time it is receiving them and interferes with the music, speech or code that others in the same neighborhood are trying to receive.

Selectivity means the ability to pick out the station you want to hear; to receive one station without being bothered by others. It can be obtained only at the expense of high-class engineering, and the use of many parts. It costs money to build a selective set, and, by the time the profits of the manufacturer, the jobber and the retailer have been added to the first cost, the beginner or anyone else has to pay a good price. Whether it is worth it or not depends upon the point of view.

There are young men who like to dance on a crowded floor, catching scraps of conversation from passing couples, and there are those who prefer a quiet bench shaded from the moonlight, where they can concentrate on the words of one fair damsel with no distracting influences. Three average women can hold a conversation, all talking at once, and a week later any one of them can repeat what she said and what the others said down to the last detail, plus the natural growth of the story that has occurred in the meantime. But the average man, after listening to his wife in silence for five minutes, will be unable to remember an hour later whether she asked him to bring home a loaf of bread or a cake of soap. That is the difference between individuals, and the same differences appear when they use radio.

The person of unselective temperament enjoys having a lot of things going on at the same time. He will get enjoyment and profit out of a radio receiver that will not narrow itself down to a single station. The higher grade amateur, on the other hand, wants to be able to bring in the weakest, most distant station, and he is impatient over the slightest interference. So it is up to the beginner to decide what manner of man he is and what kind of a receiving set he wants.

For myself, I often enjoy the broad, unselective tuner. As I write these words I have the phones on my head and they are attached to a crystal detector. That constitutes the entire receiving outfit, unless I include the single-wire antenna on the roof and the short grounding wire that is attached to the steam radiator. It is no more selective than a funnel that lets through anything that is dumped into it. Any wave that affects the antenna runs down to me, and, if it is strong enough, it pushes through the resistance of the detector, vibrates the diaphragm of the phone and makes me hear sounds.

I hear an amateur calling. His call letters tell me that he is in my own radio district, and by looking up the letters in the list, which I purchased from the Superintendent of Documents, Government Printing Office, I can find out what his name is, where he lives, and how much power he is putting into his transmitter. He is using the International Morse Code, called also the General Service Code. Having learned the code, I can understand what he says, and it interests me. He is "CQ-ing" to see if he can raise another amateur. He repeats the letters "CQ" over and over again, adding

(Continued on page 1024)

Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

"B" BATTERY POTENTIOMETER

(102) Alexander Spencer, Rahway, N. J., wants to know:

Q. 1. Which gives better results, a tapped "B" battery or a "B" battery potentiometer?

A. 1. For very best results, a "B" battery potentiometer is advantageous, although for ordinary broadcast reception, a tapped "B" battery would be found satisfactory.

Q. 2. If a potentiometer is used, how should it be connected?

A. 2. A "B" battery potentiometer is shunted directly across the "B" battery, with a switch in series. The center arm or slider, as the case may be, is used as one "B" battery lead, and the positive side of the "B" battery as the other lead.

INSULATED WIRE FOR AERIAL

(103) Geo. W. Walthes, Toledo, Ohio, asks:

Q. 1. Could rubber covered Number 14 copper wire be used for an aerial, and will the efficiency be reduced by so doing?

A. 1. Rubber covered wire will answer very well in the construction of an antenna, and will not impair the efficiency of the same in any way.

Q. 2. What is the best mineral for a crystal detector?

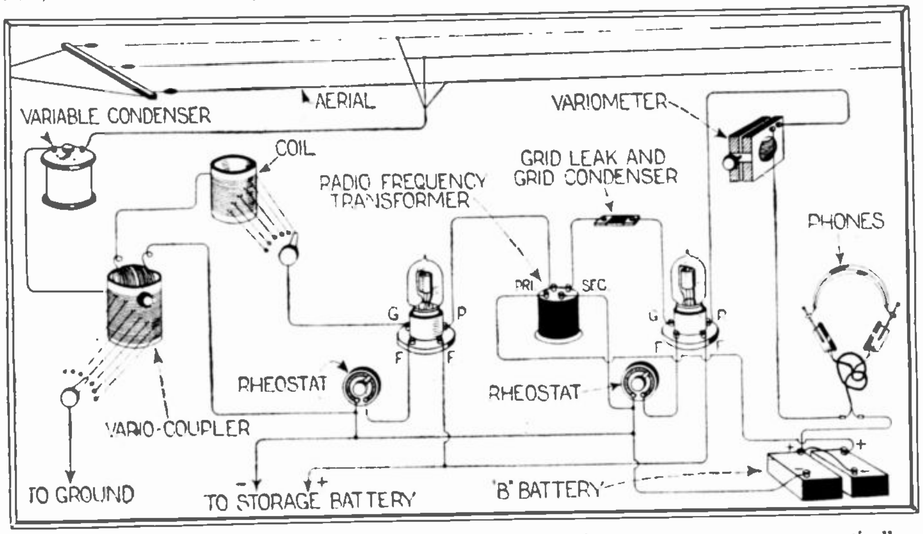
A. 2. Undoubtedly the best mineral, all things considered, although it requires a very light contact, is galena. More stable than this are copper pyrites, zincite, and silicon. For a very stable detector, that is, one that will not jar out of adjustment easily, use silicon with a fairly heavy contact.

REGENERATIVE TUNER

(108) Ben Brough, Des Moines, Iowa, requests:

Q. 1. A circuit diagram of a set employing a loading coil, a vario-coupler and a variometer. The loading coil consists of eighty turns of wire on a 3-inch tube, tapped. This tuner is to be used in connection with one step of radio-frequency amplification and a detector.

A. 1. We give herewith a circuit diagram as requested. We would recommend that you place your loading coil in the grid circuit of the first tube as shown rather than in series with the antenna. This will form a more stable and more easily operated regenerative tuner.



It is not necessary to use a variometer in the grid circuit of a short wave tuner as practically the same results may be obtained by means of a tapped coil as shown above. Regeneration is controlled by means of the variometer in the plate circuit of the detector tube. Finer tuning may be obtained by shunting the tapped coil and the secondary of the vario-coupler with a variable condenser.

A. C. ON VACUUM TUBES

(111) Robert Hirst, Manaimo, B. C., Canada, says: I am contemplating the construction of a receiving set which requires a 6-volt "A", and a 22½-volt "B" battery. He asks:

Q. 1. Can I not operate this set on the alternating current supplied for house lighting purposes?

A. 1. The question of operating tubes on A. C. has been discussed time and again in both SCIENCE AND INVENTION and *Radio News*. However, it is generally conceded that alternating current is not advisable for use where only a single vacuum tube is employed. Therefore, since you are using only one tube and this takes only a 22½-volt "B" battery, we believe that you would obtain greater satisfaction with less trouble by the use of batteries instead of A. C.

AMATEUR LICENSES

(112) Alfred E. Hopper, Jr., Ulster, Highland Co., N. Y., asks:

Q. 1. Whom must I write to regarding the securing of an amateur ratio transmitting license?

A. 1. You should write to the nearest radio inspector, who, in your case, is located at the Customs House, New York City.

Q. 2. How are the code tests given?

A. 2. An omnigraph or automatic sending machine is employed to transmit at the required rate of speed.

Q. 3. What is the wave length of a three-wire antenna 95 feet long and 25 feet high?

A. 3. Approximately 225 meters. We would advise you to reduce the length to 60 feet in order to use the same for transmission.

STATIC ELIMINATION

(104) David Browning, Jr., Ashland, Ky., asks:

Q. 1. Will you please tell me if static could be eliminated or reduced by a device such as a tube of neon gas, as is used in detectors of faulty ignition on automobiles, connected between aerial and ground.

A. 1. We do not see any reason why a tube such as you suggest, should eliminate or reduce static, inasmuch as a neon tube operates on the same principle as the vacuum tube lightning arrester. If this device would reduce static, we are sure that the makers would make this claim instead of merely saying only that the device will furnish protection against lightning. Static can be greatly reduced by the use of a loop antenna and radio-frequency amplification.

Q. 2. Is static positive or negative?

A. 2. Static is either positive or negative, the polarity not having been as yet positively determined.

LOUD-TALKER ON CRYSTAL

(105) R. A. Brayman, Portland, Oregon, wants to know:

Q. 1. Can a transmitter button be used in connection with a crystal receiving set, so that a loud-talker may be operated.

A. 1. A transmitter button cannot be used effectively with a crystal receiving set, unless the signals are extremely strong, and even then it is not marked with any great degree of success for amplification purposes.

AN IDEAL RECEIVER

(106) Robert F. Allen, Jr., Hobart, Okla., asks:

Q. 1. What do you consider to be the best tuning instruments for use with a single audion tube, and how should they be connected?

A. 1. We would advise that the best all around amateur's set, using a single audion bulb, was illustrated in the *Radio Oracle* in the June issue of SCIENCE AND INVENTION under question No. 17.

LIGHTNING ARRESTER

(107) Karl C. Huffman, Paulding, Ohio, encloses a diagram of a lightning arrester employing two flat plates, .05 inch apart. He asks:

Q. 1. Would this gap be satisfactory, and if not, can you give me any further suggestions?

A. 1. The best way to construct a simple lightning arrester is to have two pointed rods placed together end to end, similar to a spark gap, with a space between them of about the thickness of a piece of paper. The discharges will take place between the points much more readily than between flat surfaces.

MARCONI MAGNETIC DETECTOR

(109) B. B. Hopkins, Towson, Md., wants to know:

Q. 1. How should a Marconi magnetic detector be connected in place of a galena detector?

A. 1. A Marconi magnetic detector may be connected in place of an ordinary crystal detector, by connecting the primary or inner coil in place of the detector, and connecting the phones to the secondary or low resistance coil.

ELECTROLYTIC DETECTOR

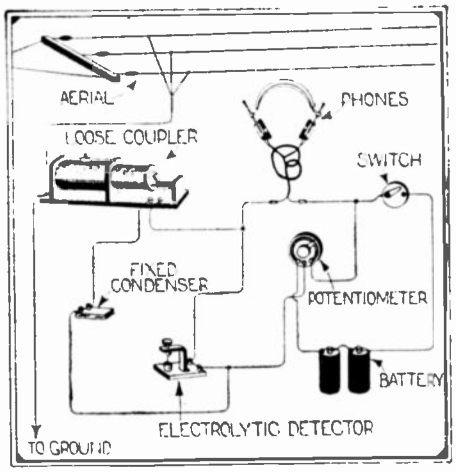
(110) H. W. Zuck, Yorktown, Texas, requests:

Q. 1. Kindly give me a circuit diagram showing how to use an electrolytic detector.

A. 1. We are giving herewith the hook-up as requested. A potentiometer should always be employed for the proper regulation of the current, which may be furnished by two or three dry cells.

Q. 2. When using my electrolytic detector, I always hear a hissing sound. How may I reduce this annoyance?

A. 2. We would inform that you will always hear a certain amount of hissing when using an electrolytic detector. In order to diminish this you should try using hydrochloric or sulphuric acid instead of the nitric acid you are now employing.



A hook-up for an electrolytic detector, or any other detector requiring a local battery is shown above.

FREAK REGENERATIVE CIRCUIT

(113) S. H. Hoffmeister, San Antonio, Texas, sends us a diagram of a circuit he is using and asks:

Q. 1. Why, when I use this set, do I encounter an internal hum and shriek which interferes with legible reception? This, at times, can be reduced or eliminated by touching the grid lead with the finger.

A. 1. The circuit you sent us is a freak regenerative circuit, and this is the reason that you encounter an internal hum and shriek that must be remedied by special methods as you mention. Freak circuits, at times work extremely well, and at other times are just as bad as they were good.

Q. 2. Would inserting two variometers in this circuit help matters any?

A. 2. You might also try inserting two variometers as you suggest, and also a grid leak, and try out the circuit. You could not do any harm whatsoever, and you might obtain somewhat better results.

LONG DISTANCE RECEPTION

(114) John Hendricks, Farmersville, Ill., says, I am using a standard short wave regenerative tuner and loud-speaker but do not get distant stations satisfactorily. He asks:

Q. 1. Would a two stage power amplifier assist in receiving DX?

A. 1. A two stage power amplifier will not enable you to receive stations further away. We would suggest that you add two or three stages of radio-frequency amplification to this outfit. If the stations cannot be heard in a pair of receivers, a power amplifier will surely not bring them in, said power amplifier being employed for furnishing the loud-speaker with a greater amount of energy.

TROUBLE IN RECEPTION

(115) A. M. Henion, Perryville, Md., sends a diagram of his hook-up, and says that he is using a large loose coupler for tuning. He asks:

Q. 1. Why can I only receive radio telegraph and not radiophone on this set?

A. 1. The reason that you do not hear the radiophone broadcast, is probably because the loose coupler you are using for tuning is of too long a wave length, and in connection with the aerial you are using, cannot tune down to the wave used by the broadcasting stations.

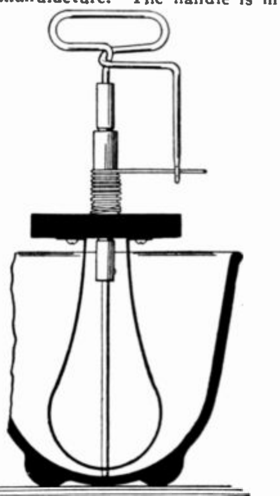
We would advise you to employ a vario-coupler in place of the loose-coupler, or much better still, a short wave regenerative set, such as was described in the December, 1921, issue of SCIENCE AND INVENTION, by William H. Grace, Jr.

LATEST PATENTS

Egg Beater

(No. 1,437,133, issued to Le Roy J. Dekin)

We are showing this device as an example of ingenuity and inexpensive manufacture. The handle is in

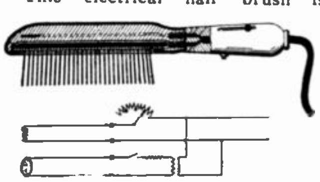


the form of a single piece of wire, bent to the shape illustrated. A brass or other metal bearing is secured to this and a weighted flywheel, to which the vanes of the beater are attached, is then mounted upon the wire holder and another bearing put in place. A piece of twine completes the beater. The device is placed in a bowl, containing the eggs or cream to be whipped, the operator grasps the handle and then winds a cord upon the shaft. By giving the free end of the cord a sharp pull, the weighted wheel is caused to rotate rapidly.

Electrical Hair Brush

(No. 1,436,957, issued to Birdie Harvey)

This electrical hair brush is

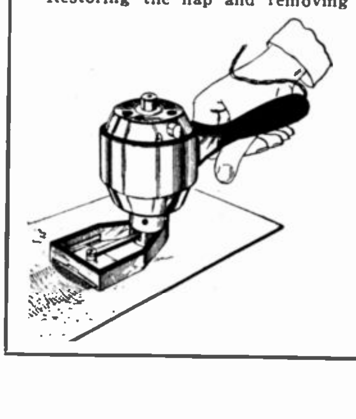


equipped with a heating element for drying the hair, and a specially arranged circuit for the treatment of the scalp by means of electricity. By means of a flexible conductor and plug it may be attached to the regular lamp socket. In the handle are found the switches for operating the electric circuits, and a rheostat for regulating the amount of heat generated by the element in the back of the brush.

Nap Restoring Machine

(No. 1,432,976, issued to Murray T. Donoho)

Restoring the nap and removing

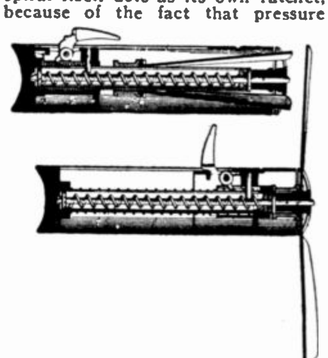


shine from old garments and clothing without destroying the fibre of the fabric, is accomplished by this rather simple machine. The shine is not removed temporarily, but to all intents permanently. The apparatus consists of an electric motor provided with a handle, and so arranged that it is at all times under control of the operator. Fitted to the bottom of this motor is a sort of shoe in which a sliding shelf with a series of pins, may move back and forth. The motor gives this pin rack a constant longitudinal reciprocating movement, causing the pins to penetrate every minute area of the garment rapidly.

Fan

(No. 1,436,850, issued to Arthur J. Aylesworth)

Because of the ingenuity of this device, we are describing it here. As will be noted in our diagram, a fan is so arranged that its wings may be folded up. This rotates on the center spindle, ball bearings at the further end taking up the thrust. A pin projects from the trigger sleeve and engages between the meshes of a long spiral spring. This spiral itself acts as its own ratchet, because of the fact that pressure

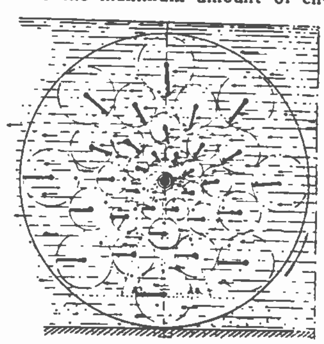


on the trigger expands it slightly projecting its free end into a radially slotted wheel rigidly secured to the propeller drive shaft.

Fluid Current Motor

(No. 1,436,843, issued to David Grosvenor White)

The manner in which this fluid current motor operates, is made clear by the diagram accompanying it. It will be seen that regardless of the direction of current flow, the wheel always rotates in one direction. The motor is made up of a number of vanes or blades with stops suitably arranged, so that at all times almost half the blades receive the maximum amount of en-

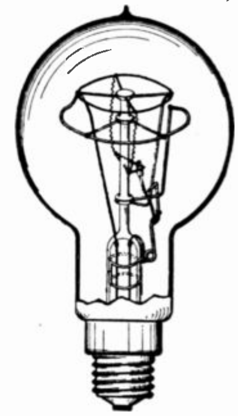


ergy from the flowing water (viz at right angles to the direction of current flow) whereas the others are free and parallel with the flowing water.

Incandescent Lamp

(No. 1,433,807, issued to Frederick A. Feldkamp)

Although this idea of an incandescent lamp is rather ingenious, there are several conditions to be found when the device will not operate, as the inventor presupposes. The lamp is provided with two filaments, and an automatic switching mechanism, which is mounted inside of the bulb on the glass stem. The upper filament is branched, and

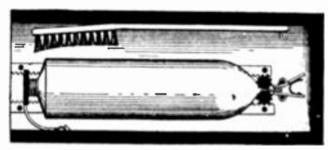


is the one which is first employed. From the center of each branch of this filament, a connecting wire leads down to a small fuse link supported by the glass stem. This fuse link holds under tension a small wire connecting spring, which is insulated at its point of contact by a glass bead. Normally there is no current flowing through the fuse link while the first filament is intact and in use. But should either branch of this filament break or burn out, the current flow is unbalanced, which, rushing through the fuse link melts it, releasing the contact spring.

Tooth Paste Tube Holder

(No. 1,435,622, issued to Charles A. Price)

A clamping device with a set of teeth, holds the top of a tube of tooth paste, so that the tube cannot fall out of the same. A roller operating on a rack bar is in back

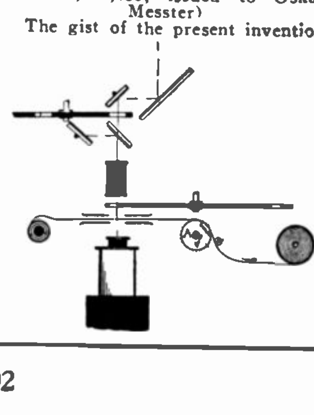


of the tube, and another is now put in front of the same, and a thumb screw inserted to lock into this. This thumb screw moves down through a slot provided for that purpose. The cap of the tube is then removed, a resilient capping member taking its place. In order to operate the device, a tooth brush is inserted between the resilient member and the tooth paste tube, and the roller given a turn by means of the thumb screw, which compresses the tube, squeezing out some of the contents.

Stereoscopic Motion Pictures

(No. 1,432,405, issued to Oskar Messter)

The gist of the present invention

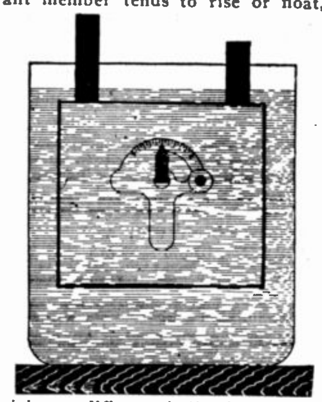


lies in the fact that a special optical system is arranged between the film picture and the movable optical compensation means. These means consist of a mirror or prism, the surface of which has stripes of silver upon it, which is mounted in front of the object glass, being inclined with respect to the same.

Hydrometer

(No. 1,432,773, issued to Thomas Midgley, Jr.)

By referring to the diagram, we will note a semicircular celluloid member pivoted in the center of its main diameter on a knife edge prolongation of a pointer which is attached to the glass jar of the storage battery. At one extremity of the sector a disc-like rubber displacement member will be observed. It is evident that as the specific gravity of the battery falls, the entire scale will rotate through a limited arc, due to the fact that the buoyancy of the displacement member is less in the lighter liquid. As the specific gravity increases, the buoyant member tends to rise or float,

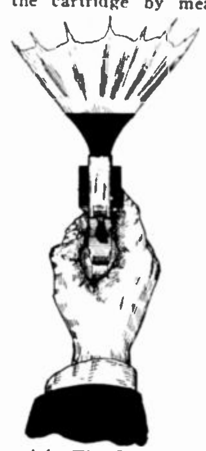


giving a different indication on the dial. This type of hydrometer is intended for glass jar storage batteries.

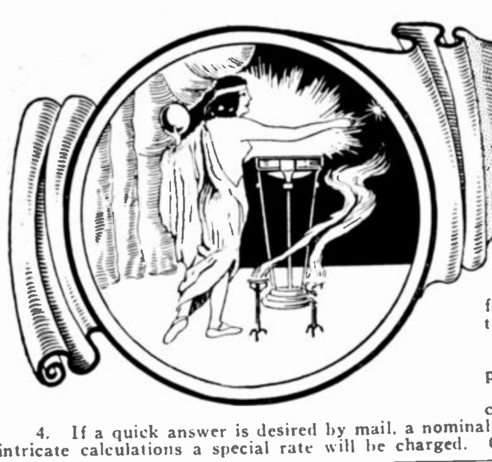
Flashlight Gun

(No. 1,436,715, issued to James O. Jackson)

An ordinary revolver, such as a .44 or .50 calibre, has its barrel removed, and a sort of fishtail burner substituted therefore. Flashlight powders for this revolver are packed within ordinary copper or paper cartridges provided with percussion primers. The powder is held within the cartridge by means of



wax material. The flashlight is now operated in a manner similar to the regular revolver, and as many shots may be fired as is desired. Due to the heat produced, the wax cap of the cartridge is burned away, being changed into the gaseous state, whereas the flaring nozzle produces a wide area of light.



THE ORACLE

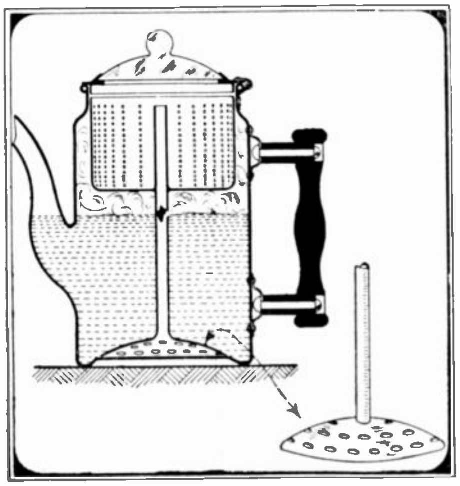
The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to the department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Coffee Percolator

(1394) Malcolm M. Cook, Nashville, Tenn., writes:

Q. 1. Explain as fully as possible the principle on which a coffee percolator operates.



Above is shown a diagram illustrating the principle upon which a coffee percolator works. Full explanation is given in the text.

A. 1. A coffee percolator works on the principle of steam pressure. We give herewith a diagram illustrating its action. When the liquid is heated, steam is given off, which fills the air space, and as it becomes compressed, forces a small amount of liquid up through the tube, so that it spurts out on the top and falls on the coffee. When the liquid spurts from the tube, the pressure within is relieved until enough steam is formed to force the water up through the tube once more. This action is repeated until the heat is removed. As the liquid falls on the coffee, it drains through and falls back into the lower section of the pot through holes in the coffee container, carrying with it the extract obtained from the ground coffee.

A Mysterious Light

(1395) H. B. Bull, Dalzell, S. C., says that there is very often seen in the vicinity of his home, a mysterious light which is locally known as a "Jack O'Lantern," and which apparently floats in the air. This light is similar to a rainbow, in that it cannot be approached, and occurs only at night when the weather is damp.

Q. 1. Can you explain this phenomena?

A. 1. The "Jack O'Lantern" which you refer to is probably what is known to science as "ignis fatuus" or "will-o'-the-wisp" which is seen in marshy districts. The cause of this light is generally decaying vegetable or animal matter. The phosphorescence is caused by slow oxidation, and if you follow the light carefully, it is possible in some cases to find pieces of decaying wood, which give off this slight. The approaching and receding effect is due perhaps to the refraction of the air.

Q. 2. Does every liberated bubble of hydrogen in the electrolysis of hydrochloric acid, represent a neutralized ion?

A. 2. Every liberated bubble of hydrogen in the electrolysis of hydrochloric acid represents millions of neutralized ions, if you want to take it that way. You can see that the bubbles will vary in size according to the amount of pressure exerted on the liquid, and also according to the strength of current used in the electrolysis. The theory of the ion is that all matter is made up of molecules, all molecules are made up of atoms, and atoms are made up of a nucleus and negative electrons. An atom which has parted with an electron is an ion.

Sulphur Lotion

(1396) J. S. Babin, North Adams, Mass., asks:

Q. 1. What is Lobion Sulphuris?

A. 1. We do not know of any chemical such as Lobion Sulphuris. Probably you mean Lotion Sulphuris, or a lotion of sulphur. If so, you may make this up as follows:

Sublimed sulphur	90 grains
Powdered borax	½ oz. av.
Spirit of camphor	1 fluid dr.
Glycerin	1½ fluid dr.
Water	3 fluid oz.

Dissolve the borax in water, add the spirits, and then incorporate the mixture with the sulphur previously triturated to a smooth paste with the glycerin.

Circular Glass Cutter

(1397) Herman M. Benson, North Falmouth, Mass., says that he has several glass plates in the center of which he wishes to cut a circle. He asks:

Q. 1. Can you give me directions for this work?

A. 1. Any hardware store can supply you with a circular glass cutter which consists of a rubber suction cup fastened to one end of a rod which is pivoted thereon, and a glass cutter arranged on the rod so that it may be slipped nearer to or further away from the cup. The method of using it is to place the vacuum cup on the glass in the center of the circle to be cut out, place the glass cutter in the correct position, and describe a circle. The vacuum cup is now removed, and several straight lines run from one side of the circumference of the circle to the other with the glass cutter. These strips are now knocked out, and the circle is left fairly smooth.

Q. 2. How can the edges of this hole be smoothed after cutting?

A. 1. A very fine file or fine carborundum stone will remove the rough edges from the glass.

Sympathetic Inks

(1398) L. Bias, Huntington, W. Va., asks:

Q. 1. Can you tell me how to make an ink which will write invisibly upon paper when viewed in ordinary light, but which writing will become visible when viewed through a red screen?

A. 1. There is to the best of our knowledge no invisible ink which becomes visible on being viewed through a red screen. We believe that such a thing is practically impossible to produce.

Carbon Preventative

(1399) H. A. Althouse, Germansville, Pa., asks:

Q. 1. Can you tell me what I must add to ordinary gasoline in order to prevent the formation of carbon in the cylinders of my automobile engine?

A. 1. As far as we know there is no real efficacious carbon preventative for gasoline engines. However, careful attention to the pistons and rings and the lubricating system as well as to the grade of gasoline and oil used will do much toward reducing the amount of carbon formed.

You may purchase at any drug store a can of what is known as "motor-ether." A pound can of this, added to ten gallons of gasoline will give a mixture which will fire much quicker and cleaner, thereby reducing to a certain extent the carbon deposit formed.

One way to remove carbon, and probably the simplest of all is when the motor is hot, to pour about two teaspoonsful of kerosene into each cylinder and allow to stand over night. In the morning start the motor and the carbon, which has been softened by the action of the kerosene, will be blown out through the exhaust pipe. This treatment is generally very effective.

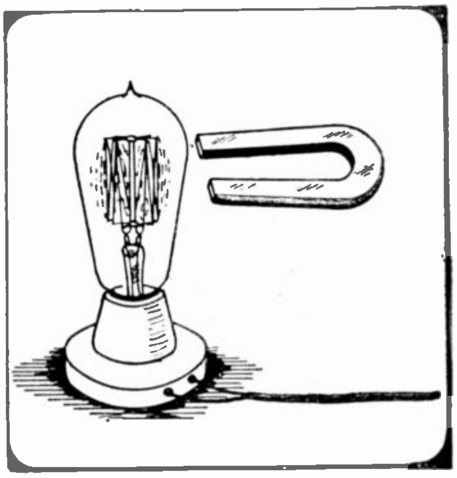
Many of the so-called carbon removers or carbon preventers which are on the market today, were found to have no more merit than kerosene according to actual tests made by the United States Government in their recent report. Burning out with oxygen gas can be done for you at a garage.

Pnenomena in Electric Light Bulb

(1400) M. Bouger, Montreal, Canada, states that he has made an experiment in which he found that when he brought a magnet near a tungsten filament lamp, the filament was deflected. He assumes that the reason for this was that the electrons emitted by the incandescent wire were deflected or attracted by the magnet. He asks:

Q. 1. Is this theory true, and has this experiment ever been carried out before?

A. 1. The experiment you tried is a very old one, and has been done time and time again. If you tried this same experiment with a tungsten wire, that was not heated by electricity, but by placing same in a forge or alcohol flame, you would not find that the wire would be deflected by the magnet. The fact is, that when an electric current passes through a wire, a magnetic field is set up about the latter. It is for this reason that the tungsten wire in an electric light bulb is deflected or bent by bringing a magnet near to the same.



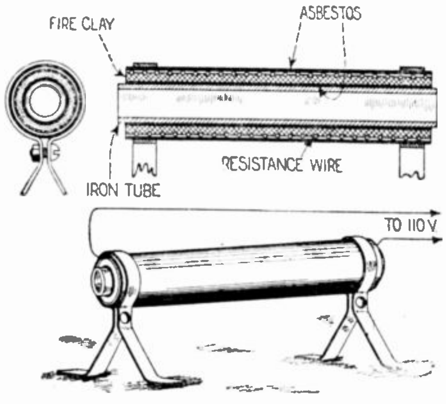
The action of a permanent magnet upon the filament of a lamp which is heated by alternating current, is plainly shown herewith. In some cases the vibration is so great that the filament may be broken in this manner.

Curling Iron Heater

(1401) Benjamin T. Anderson, East St. Louis, Mo., requests:

Q. 1. Data on the construction of an electric heater for a curling iron to be used on 110 volts.

A. 1. On an iron tube about ¾ inch in diameter by 6 inches long, with a wall 1/16 inch thick, place a thin layer of sheet asbestos. Over this



The constructional details of a curling iron heater are shown above. Data for the winding of the same will be found in the text.

asbestos place a layer of soft fire clay. On this clay wind 24 turns of No. 24 Ideal resistance wire, imbedding the turns in the clay. The purpose of the clay is to hold the turns in place. Over this may be placed a layer of sheet asbestos to protect the winding. Any sort of a suitable mounting may be used, and the ends of the wire may be connected directly to the 110-volt line.

To use this heater, place the curling iron in the tube, and turn on the current. When not in use, be sure that the current is turned off.

Synthetic Diamonds and Gold

(1402) Peter D. Barakauskey, Chicago, Ill., asks:

Q. 1. Have you ever published any articles on the making of synthetic diamonds and gold? If so, please give the issues, and if not, can you give me some information on the subjects.

A. 1. Several articles on diamonds have appeared in this magazine, and we are giving you a list of the more recent ones herewith: ALL ABOUT DIAMONDS, page 1115, March, 1920; GERMANY SAID TO MAKE PERFECT DIAMONDS, page 1072, February, 1921; DIAMONDS FROM THE ELECTRIC FURNACE, page 214, July, 1921.

We have never published any information on making synthetic gold, because as yet such a process has not been discovered. Gold is an element and cannot be made by a combination of other substances. However, imitation gold can be made, and we are giving you some formulae for that work herewith.

I. One hundred parts, by weight of copper of the purest quality; 14 of zinc or tin; 6 of magnesia; 1½ each of sal ammoniac, limestone, and cream of tartar. The copper is first melted, then the magnesia, sal ammoniac, limestone, and cream of tartar in powder are added separately and gradually. The whole mass is kept stirred for a half hour, the zinc or tin being dropped in piece by piece, the stirring being kept up till they melt. Finally the crucible is covered and the mass is kept in fusion 35 minutes, and, the same being removed, the metal is poured into molds, and is then ready for use. The alloy thus made is said to be fine-grained, malleable, takes a high polish, and does not easily oxidize.

II. An invention, patented in Germany, covers a metallic alloy, to take the place of gold, which, even if exposed for some time to the action of ammoniacal and acid vapors, does not oxidize or lose its gold color. It can be rolled and worked like gold and has the appearance of genuine gold without containing the slightest admixture of that metal. The alloy consists of copper and antimony in the approximate ratio of 100 to 6, and is produced by adding to molten copper, as soon as it has reached a certain degree of heat, the said percentage of antimony. When the antimony has likewise melted and entered into intimate union with the copper, some charcoal ashes, magnesium, and lime spar are added to the mass when the latter is still in the crucible.

III. Platinum, 4 pennyweights; pure copper, 2¼ pennyweights; sheet zinc, 1 pennyweight; block tin, 1¾ pennyweights; pure lead, 1½ pennyweight. If this should be found too hard or brittle for practical use, remelting the composition with a little sal ammoniac will generally render it malleable as desired.

IV. Platinum, 2 parts; silver, 1 part; copper, 3 parts. This composition, when properly prepared, so nearly resembles pure gold that it is very difficult to distinguish them therefrom. A little powdered charcoal, mixed with the metals while melting, will be found of service.

Acetic Acid Test

(1403) C. G. Golay, Martinsville, Ind., requests:

Q. 1. Please give me a process to determine the presence of acetic acid in wooden separators such as are used in storage batteries.

A. 1. Perhaps the best test to determine whether or not acetic acid is present in wooden separators, is by the odor resulting from an acetic acid test. In view of the fact that these wooden separators are also impregnated with sulphuric acid, this test will probably answer your purpose better than any other.

The odor resembles a very pleasant fruitlike smell. Take a small quantity of water from the vat in which the wooden separators have been standing, or boil a small quantity of shavings from the separators with water. Add to this an equal volume of alcohol and a few drops of concentrated sulphuric acid and warm gently. If acetic acid is present you will find this odor of ethyl acetate coming forth quite strongly.

Heat of Quartz Tube

(1404) Warren R. Silvera, Ford, Ontario, Canada, asks:

Q. 1. What is the temperature inside and outside a quartz mercury vapor lamp? Can it be held in the hand?

A. 1. It would be quite impossible for us to give you definite figures on the heat which is developed inside or outside of a quartz tube, as this varies greatly with the cooling qualities surrounding the tube. Mercury vaporizes at 675 Centigrade, but the arc formed within the tube is pinhead in size, consequently the actual temperature within the tube is only 125° to 150° Centigrade. Nevertheless, we would say a quartz tube, after it has been operating several minutes, can be held in the hand.

Sulphur Dioxide

(1405) R. E. Valentine, Ozark, Ala., wants to know:

Q. 1. How can sulphur dioxide be made?

A. 1. Sulphur dioxide may be very simply prepared by merely burning sulphur in oxygen, or by acting on a sulphide with sulphuric acid; if burned in air the gas will be produced but will be mixed with nitrogen.

Trouble with Dry Batteries

(1406) F. A. Valente, Dorchester, Mass., says that the dry batteries used to operate the door bell in his home, become so weak after short usage, that it is necessary to renew them. He says that each time he has changed them, they seem to be very wet. He asks:

Q. 1. Please advise me how to remedy this trouble.

A. 1. Undoubtedly you are placing your batteries in a very moist place. We would advise that before setting up the batteries next time, you cover the binding posts with molten paraffin.

It is also possible that these batteries may have been shelf bound at the shop where you purchase them, and when they were out on the circuit, it required but a short run to end their usefulness.

Zoological Chart

(1407) B. L. Hornady, New York City, asks:

Q. 1. Is there any chart for one interested in the study of zoology, which will make the classifications in the animal kingdom easier to memorize?

A. 1. If you will send a stamped self-addressed envelope, we will be glad to furnish you with the name and address of an individual who has published a most complete chart, giving the classifications. This chart will be of value to anyone seriously taking up the study of zoology, both the Latin and English names are given with a few words concerning the nature of animals in each phylum.

Talking Stones

(1408) Lucien Adrianowski, New York City, N. Y., refers to the article on "Stones That Talk," which appeared in this magazine, and asks:

Q. 1. What kind of current should be used in order to produce the electrical attraction through the lithographic stone?

A. 1. Regarding the experiment of "Stones That Talk," we would advise that D. C. must be used. Consult the article on page 307 of Practical Electrics, June, 1922.

Q. 2. What thickness and kind of lithographic stone should be used?

A. 2. Either yellow or blue gray lithographic stone may be used, and you will find that the attraction between the two plates will vary according to the thickness of the stone employed.

Hydrogen

(1409) Ellwood Anderson, Jacksonville, Fla., asks:

Q. 1. How is hydrogen prepared commercially by electrolysis?

A. 1. Hydrogen is prepared commercially by the electrolysis of water on a large scale in just the same manner as it is prepared in the laboratory except instead of platinum anodes and cathodes, large carbon or iron plates are used.

Q. 2. What voltage and amperage is used in the larger commercial plants?

A. 2. In the larger stations several thousand amperes are employed while the pressure ranges anywhere from one and a half to two or more volts. Hydrogen and oxygen are collected as gases in their separate compartments, and led away through pipes to their respective pumps where they are compressed into steel cylinders.

Soft Drinks

(1410) Anthony Azzopardi, New York City, N. Y., requests:

Q. 1. Can you give me formulae for the preparation of cherry cordial, ginger ale and pineapple-ade?

A. 1. We give herewith the formulas for soft drinks as requested:

CHERRY CORDIAL

To ½ gallon syrup made of sugar and water, add ½ ounce artificial essence of black cherry and ½ ounce of fruit acid solution. This is improved by the extract of wild cherry. This contains tannic acid and should not be placed in iron receptacles.

GINGER ALE

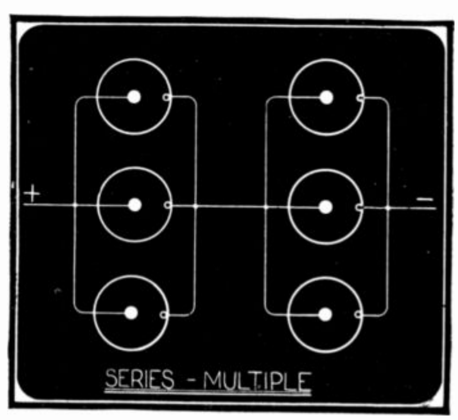
One ounce tartaric acid; white sugar, 5 pounds; 1½ pounds bruised ginger (root); 12 gallons of water; whites of 6 eggs beaten to a froth; oil of lemon, 2 drams. The ginger root should be boiled for one-half hour in 2 gallons of water; add the other ingredients; strain carefully and add the oil. After twenty-four hours strain and bottle.

PINEAPPLE-ADE

Pare some fresh, ripe pineapples, and cut them into thin slices; then cut each slice into small bits; put them into a large pitcher, and sprinkle powdered white sugar among them; pour on boiling water in proportion of ½ gallon of water to each pineapple; cover the pitcher, stop up the spout with a roll of soft paper, and let the pineapples infuse into the water until it becomes quite cool, stirring and pressing down the pineapple occasionally with a spoon, to get out as much juice as possible. When the liquid has grown quite cold, set the pitcher for a while in ice. Then transfer the infusion to tumblers, add some more sugar, and put into each glass a lump of ice. You may lay a thin slice of fresh pineapple into each tumbler before you pour out the infusion.

Correction

Attention has been called by several readers to an error which occurred in the Oracle Department, in answer to question No. 1324, appearing in the October issue. This item showed three methods of connecting up dry cells, one of which was called "series multiple." This connection should have been entitled, "multiple series," as "series multiple" gives an entirely different connection. We give herewith the correct "series multiple" connection, and wish to thank our readers for calling our attention to this inversion of words.



An addition to the dry cell connections shown in this department in the October issue, is given above. This particular combination gives the voltage of two cells and the combined amperage of three.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page 970*)

consider the advantages such a telescope as the 120-inch would offer for observing the surface of the moon or planets.

The greater the diameter or aperture of a lens or mirror the greater the magnifying power that it will stand and the nearer it will bring a celestial object. The distance to which the object will be brought by magnification of the image equals the distance of the object in the heavens divided by the magnifying power used in examining the image. For example, the moon is about 240,000 miles from the earth. A binocular with a magnifying power of 10, say, will bring the moon within $\frac{240,000}{10}$ or 24,000 miles of the earth. A powerful telescope with a magnifying power of 3,000 will bring it within $\frac{240,000}{3,000}$ or 80 miles of the earth.

The magnifying power that a telescope will stand has been found from experience to run from 30 to 100 for each inch of diameter, or aperture, of the lens or mirror. The magnifying power that it is advisable to use will depend upon the condition of the atmosphere or 'seeing' conditions, and it is important to bear in mind that a powerful telescope will not behave anywhere near as well with high magnifying powers as a smaller telescope, for the reason that atmospheric disturbances increase enormously under high magnification. For instance, a magnifying power of 100 per inch of aperture can be used under exceptionally fine observing conditions with a moderate-sized telescope, but it would be rarely, if ever, used with a 100-inch telescope; and if used, the results would be most disappointing.

A six-inch telescope with a power of 100 to the inch would magnify the object under observation 600 times. A 100-inch telescope with a power of 100 to the inch would magnify the object *ten thousand* times. In the first case, the effects of atmospheric disturbances would be magnified 600 times; in the second case, 10,000 times. As a result, the first instrument would show a comparatively small image with fairly clear-cut detail, while the second instrument would show a blurred and wavering image of great size, but worthless to the student of planetary detail because the disturbing defects of the intervening atmosphere are so enormously increased under high magnification.

There are those who seem to think that if we view the moon with a telescope of great light-gathering power and a magnification of 10,000, we then might almost be able to see veins of gold if they exist in the lunar rocks! As a matter of fact, we would have a blurred, indistinct image having, indeed, great detail but with an obscuring veil over it, due to the presence of our own atmosphere. As regards the brightness of the image of the moon or Mars formed by the telescope, it is well to bear in mind that the moon or any extended surface never appears brighter in the telescope than it does to the naked eye; for, although the telescope gathers more light from the object than the naked eye, it is spread out by magnification over a much larger area, and for this reason the brightness of the image is not increased.

Under poor seeing conditions as low a power as 30 to the inch is often used, and such a power is more frequently used with large telescopes than with small ones. Under fair atmospheric conditions a power of 50 or 60 to the inch may be used to advantage. Under superlative conditions, when the air is exceptionally clear and transparent and, what is of chief importance, comparatively free from rising or descending currents and eddies, a power of 100 to the inch may be employed; but such occasions are rare over the greater part of the world.

The magnifying powers that might be used theoretically on an image formed by a 120-inch telescope would range from 3,600, or less, to 12,000. The latter magnification would rarely, if ever, be used. For a 100-inch telescope, the powers used would be about the same, ranging, according to the general rule, from 3,000 or less to 10,000. The magnified image in the 120-inch should be, for equal magnifying powers, somewhat brighter and should show a little more detail than the corresponding one in the 100-inch. In general, the smaller powers of 1,500 or 3,000 would be used the most with either telescope, for atmospheric conditions are generally poor most of the time in most localities.

It may be interesting to consider how Mars would appear in a powerful telescope and how near such a telescope would bring this planet of mystery, although astronomers who have devoted the greater part of their lives to a study of the Martians features generally maintain that the largest telescopes and high magnifying powers are not as satisfactory for showing details of surface markings as moderate-sized telescopes and lower powers. This is due, of course, to the disturbances produced by our own atmosphere. If they could be used outside of the earth's atmosphere there is no doubt that the largest telescopes would be the most valuable.

Viewed with a two-inch telescope and a power of 75, Mars is of the same angular diameter as the moon as it appears to the naked eye, though one viewing the small ball in the telescope would never think so, owing to the fact that in viewing the moon in the heavens we unconsciously magnify it.

Viewed with a power of 1500, such as might be used to advantage with a 100-inch or 120-inch telescope, Mars would be of the same size as the moon magnified 20 times; that is, the moon as it would appear in an ordinary spy glass magnifying 20 times. It would show far less detail than the moon would show in the spy glass, however, for the high magnifying power used on Mars would make its markings appear more indistinct by magnifying atmospheric disturbances. The moon, on the other hand, magnified to the same size with a power of 20 would present a sharp, clear-cut image. Moreover, the Martian atmosphere, rare though it is, would add to the difficulties of observing surface markings, while the moon has practically no atmosphere. Also, the brightness of the lunar image greatly exceeds that of the image of Mars, which is extremely faint under high magnification.

With a magnifying power of 7,200 used with a 100-inch or 120-inch telescope, the disk of Mars would appear to be of the same size as the moon magnified 96 times; that is, the moon as it would appear in a two-inch telescope viewed with the moderate magnifying power of 48 to the inch, or the moon as it would appear to the naked eye at a distance of 2,500 miles from the earth.

In viewing Mars with either one of these powerful telescopes, it would be useless to press the magnifying power to the limit owing to the enormous increase in atmospheric disturbances under such circumstances.

The only advantage that a 120-inch telescope would possess over a 100-inch telescope would lie in the fact that for the same magnifying power the 120-inch would

(*Continued on page 998*)

Popular Astronomy

(*Continued from page 996*)

give a brighter image than the 100-inch and would show a little more detail.

The size of the smallest object that can be seen on the moon or a planet with a given telescope depends upon the resolving power of the telescope. The least distance between two points in the heavens—as two stars, for example—that the human eye can distinguish is about four minutes of arc. If two stars are closer together than this, they would appear as one. The limit of the resolving power of the human eye, then, is 4'. The limit of the resolving power of a telescope, known as Dawes' Limit, is $\frac{4'.'56}{A}$ in which A is the diameter, or aperture, of the lens or mirror. This amounts to 2'.'56 for a 2-inch telescope, 0'.'76 for a 6-inch, 0'.'046 for a 100-inch and 0'.'038 for a 120-inch telescope. In other words, these numbers represent in each case the least distance by which two stars or points in the heavens can be separated and still be seen as separate objects. In observing planetary or lunar detail, we may consider that this resolving limit represents the diameter of the smallest object, as a crater, or ray on the moon, or a 'canal' or 'lake' on Mars that could be distinguished with the telescope in question. For powerful telescopes this limit has been found to be always too high. To transform these angular values into miles, we must know the diameter of the object under observation both in arc and miles. The diameter of the moon in miles is 2,160 its diameter; in arc it is about 31'. The diameter of Mars in miles is about 4,200 and at nearest approach to the earth its angular diameter is about 25". From this we find that one mile on the lunar disk subtends an angle of about 1" and one mile on the disk of Mars an angle of about 0'.006. It follows, then, that with a two-inch telescope one should be able to distinguish an object on the moon about three miles in diameter, and on Mars an object 430 miles in diameter. For a six-inch telescope we find that nine-tenths of a mile is about the limit of visibility of objects on the moon and 128 miles the limit of visibility for objects on Mars. For a 100-inch telescope, the limits are 290 feet for the moon and eight miles for Mars. For a 120-inch telescope they are 240 feet for the moon and six miles for Mars.

These are the theoretical limits. Whether they are actually attained depends as much on the conditions of seeing and the skill and keenness of vision of the observer as upon the resolving power of the telescope.

How Mosquitoes Spread Malaria

By CHARLES FREDERICK CARTER

(*Continued from page 969*)

cycle of existence. The opportunity is not long in coming if there are any human beings around, for the female anopheles is an indefatigable hunter.

As she bores ruthlessly through the skin of her victim she moistens the drill with saliva, not out of regard for the victim, but to protect the drill. The saliva is swarming with sporozoites which rush joyously through the aperture the instant the skin is punctured, even before the mosquito can begin to feed. The first red corpuscle that comes floating along in the blood stream is attacked by the sporozoites which bore into it and immediately enter upon their second cycle of life.

Just as they did in the body of the mosquito, the cells increase in number by division until the new cells, called "Merozoites," completely fill the corpuscle and destroy it. This releases the mass into the victim's blood stream, whereupon they immediately attack a great number of red corpuscles. In a very short time there are countless billions of these parasites at work. They and the poison they throw off into the blood so change its character that the victim at last becomes ill with malaria, the characteristic symptoms of which are chills and fever.

Occasionally the disease itself may result in death. More often it so weakens the constitution that the patient lacks the strength to throw off other disease; at the very least the consequences are long continued wretchedness.

The conclusion of this vivid and impressive lesson is that malaria like yellow fever, the latter is also carried by mosquitoes, shows that these diseases can be eliminated by screening all malaria patients until they are cured; by screening all well persons from mosquitoes; by draining or filling all breeding places for mosquitoes; by oiling ditches and ponds to kill larvæ and pupæ; by giving quinine daily to all persons exposed to bites of malaria-infected mosquitoes.

Certain individuals believe that it is possible to transmit diseases, such as malaria, to their progeny. Let us make it clear that diseases of this nature are never transmitted, are never handed down, so to speak, to the offspring. Before birth the blood of the unborn infant is not in any way directly connected to its mother, no more so than the blood in the human being is in direct contact with the air. Malaria germs attacking the red blood corpuscles of the parent do considerable damage. In this way the child's nourishment may be decreased, due to a lack of blood cells on the part of the parent, but the parent's blood does not flow through the veins and arteries of her unborn child. Consequently, it is quite impossible to transmit the disease, unless we puncture the blood vessels of the child and force some of the parent's blood also from a wound or puncture, to enter the arterial system of the infant. Any good book on embryology will confirm the above statements, and convince doubting Thomases of the truth of these assertions.

It is interesting to note that a mosquito which has bitten a person infected with malaria, dies of the same disease. Of course, it may infect many individuals before the parasite itself succumbs to the effect of the malaria bacilli, but if malaria patients were screened off the moment that the germs were sent into their system (quite an impossibility, of course), the ravages of this disease would be considerably diminished. If a frog had wings, and was really ambitious, it could in a short time devour millions of these insect pests. Unfortunately, Dame Nature has not provided a frog with wings, and the disease must be combated in other ways. Every effort is now being made to drain swamps or to spread a layer of oil upon them, which prevents the larva of the mosquito from breathing. Animals are cultivated which wage a continual war on these pests. The time will come when a mosquito will be almost as unknown as bisons are. For this, everyone's cooperation is needed, and every safeguard made to prevent transmission of the disease by screening the patient from the ravages of the female anopheles and by destroying stagnant pools.

The Poly-Lingual Typewriter

(Continued from page 946)

may be placed over the "ñ"—true the wave is straight instead of curved, but it is never likely to be misunderstood by anyone reading Spanish. With the equipment mentioned above, all French or Spanish words may be written, as the accents may be struck over any letter, by back-spacing after having struck the letter. Thus we may make: (French) français, père, général, répondit, à, Noël, etc. (Spanish) español, aquí, próxima, saqué, árbol, linguistica, etc.

It is to be seen that all the above can be done with one back-spacing for each letter modified. Some other languages, such as Italian and Portuguese, may also be written with the same equipment, for example: (Italian) avrò, felicità, così; (Portuguese) nós não, acqueçamos, terás.

Certain Slavic languages may also be written with the above equipment, but certain of the modified letters require two back-spacings and a combination of two marks. The modified letters for Polish, Croatian and Bohemian are shown below with the method of forming each letter.

POLISH

ć, ´ over c — ę, ˛ under e (•) — ł, - on l
ń, ´ over n — ś, ´ over s — ť, ´ over t
ı, . over ı — ĭ, ˇ and ´ over ı — ą, ˛ under a

CROATIAN

ć, ´ over c — č, ˋ and ´ over c — ń, ´ over n
— š, ˋ and ´ over s — ž, ˋ and ´ over z —

BOHEMIAN

ć, ´ over c — č, ˋ and ´ over c — ê, ^ over e
ň, ˋ and ´ over n — ś, ´ over s — š, ˋ and ´ over s
— ź, ´ over z — ž, ˋ and ´ over z —

(•) WHERE A MARK IS LABELLED UNDER, IT MEANS THAT THE LINE SPACE MUST BE RAISED TO MAKE THE CHARACTER STRIKE BELOW ITS NORMAL ALIGNMENT

New Music Staff

(Continued from page 965)

be learned. Such a thing as a sharp or a flat is not known on this new arrangement. The natural notes themselves are written in the spaces and the sharps or flats are written upon the lines. The arrangement in seven staffs means that by numerically designating the octaves on the piano, at a moments notice the proper note in any position can be correctly struck. Within 30 minutes a normal pupil can learn the entire keyboard, and pupils are able to read piano music written in two hands slowly after having taken two lessons.

Each individual octave, as stated before, is exactly similar to the preceding one, so that it really does not make any difference where the music is started, it still will be in the same key. Such a thing as a base clef is not known. Neither is a treble clef known, and the letter positions of the various notes, which in the old-style methods are changed in the clefs do not differ in the modern system. In changing from one key to another the reader does not have to memorize a lengthy discourse on sharps and flats and naturals. He continues to play without any trouble. The only objection which one can validly offer to such a staff is the fact that we are used to the present system and consequently it would be hard to change over, just the same as our present foot-pound-second method would be difficult to convert into the much more rational, centimeter-gram-second, or metric system.

Answers to Scientific Problems and Puzzles

(Continued from page 971)

WEIGHING THE ELEPHANT

There are a number of methods by which an elephant or other large object can be weighed without the use of special weighing apparatus. One way is to put the elephant on a barge or boat with vertical sides and measure the change in water line produced by the elephant's weight. Knowing the dimensions of the boat and the change in water line, one can readily calculate the volume, and hence the weight, of water displaced. This weight would equal the weight of the elephant.

Another way is to put the elephant into a pit or tank full of water. If the elephant floated in the tank his weight could be found by measuring or weighing the quantity of water overflowing from the tank.

But simple as these methods are the one used by the boy who succeeded with the problem is at least more primitive if not more direct. According to the story, he led the elephant into a boat, marked the water-line, led the elephant off again, and then filled the boat with stones until the weight of the stones lowered the boat to the same water-line as that produced by the elephant. The weight of the stones then gave him the weight of the animal.

WEIGHING THE FISH

First, the fisherman balanced the pole of known weight across the edge of the jack-knife. The point at which it balanced (center of gravity) he marked with a slight scratch. Then tying the fish to near the lighter end of the pole, he again found the point of balance (fulcrum). The weight of the pole (say, 2 lbs.) times the distance of the center of gravity of the pole from the fulcrum (say, 3 ft.) divided by the distance of the fish from the fulcrum (say, 1.5 ft.) gave him the weight of the fish itself (in this case, 4 lbs.).

REVERSAL OF ROTATION IN MOTION PICTURES

The apparent backward rotation of wheels in motion pictures is easily understood if one stops to consider what may happen between successive clicks of the camera photographing the action. During this interval of perhaps a sixteenth of a second the spokes may turn through one of the various angles subtended by different pairs of spokes. If this happens the successive exposures will photograph the spokes in apparently the same position each time, with the consequence that the wheel will appear to stand still.

On the other hand, if the wheel rotates just a little slower than would be required for the above effect, each successive picture will reveal the spokes a little behind whatever position they had during the previous exposure, with the result that the wheel will appear to turn slowly backward.

FREEZING WATER PIPES

The presence of any dissolved substance in a liquid tends to lower the freezing point of that liquid. Thus water containing a little salt or sugar will freeze at a lower temperature than pure water. The effect of a gas dissolved in the water is much the same. Thus cold water contains dissolved air, and accordingly freezes at a little lower temperature than water which has been heated and thereby lost much of the air which it held in solution. Now as water standing in the hot water pipes has less air in it than the water in the cold water pipe, it is natural that it should have a little higher freezing temperature and consequently freeze first.

One might think that the heat from the furnace would warm the hot-water pipes considerably; but this is not the case, unless the water is allowed to run through the pipes, as any heat that is conducted by the pipe is necessarily small and is quickly lost to the air.

THAT RATTLING GOOD CAR

All parts of a car that are free to vibrate have a tendency to do so at some particular rate. This will not seem strange if one recalls that a child's swing moves backward and forward at a rate dependent upon the length of the supporting ropes. Similarly, a thin metal strip with one end clamped in a vise will vibrate at a definite rate which will be more rapid if the strip is light and short, and slower if the strip is heavy and long. Now if the strip receives impulses at regular intervals which always reach it in the same phase of its vibration the result will be a more sustained vibration than it would have if the impulses came irregularly or out of phase.

So it is with the car. The fenders, brake rods, hood, etc., each have a natural frequency of vibration. If the motor is running at just the right speed the jars produced by the explosions in the cylinders will be in tune with some vibrating part of the car, with the result that this part will vibrate with unusual vigor and thus give rise to the characteristic rattle for that particular speed.

MELTING SNOW IN COUNTRY AND TOWN

It is of common remark that, due to smoke, the snow in the city and town looks dark and gritty in contrast with the immaculate appearance of the snow in the open country. Couple this observation with the fact that a black or dark surface absorbs light and heat quite readily while a white or bright surface reflects it away and you have accounted for the more rapid disappearance of the snow in urban communities.

THE PROBLEM OF THE HOIST AGAIN

Contrary entirely to what one would naturally expect on first inspection, the pulley system shown in this issue would not balance with any combination of effort and resistance, for the reason that it is possible for both weight and effort to lower at the same time. To be assured of this fact, imagine that both weight and effort are held fixed. Now let pulley *M* be lowered by some amount, say one foot. Ordinarily this would mean that the ropes would either have to stretch or break. But not so in this system. If pulley *M* comes down one foot it will release 2 feet of rope which can slip around pulleys *N* and *O*, thus lowering pulley *P* one foot also. Now if *P* lowers by 2 feet it will release 4 feet of rope, only 1 foot of which will be required by pulley *M*. The remaining 3 feet, then, is slack which would allow both effort and weight to descend if they were not held in place.

For the pulley system shown in the September issue the answer should have been that a force of 100 lbs. on the rope held by the man would balance a weight of 200 lbs. on the lower pulley, the weight of pulley and ropes being neglected.

Artificial Silk--How Made

By SAMUEL WEIN

(Continued from page 949)

In order to reduce the danger of inflammability a great number of patents were granted for the use of alkaline hydrosulphides as the coagulating medium. The object of such a solution is to de-nitrate or rather reduce the nitrate to a compound that is less inflammable.

There is only one firm in the United States actually working on this particular process, and they manufactured in the last year 845,000 pounds of artificial silk.

THE VISCOSE PROCESS

The second distinctive process consists in treating cellulose with ordinary caustic soda until it is fully mercerized; the cellulose is thereafter ground to the form of a fine bread-like crumb, then treated with carbon disulphide in a rotating hexagonal tumbler. The resulting compound is then treated with caustic soda solution to form the viscous solution desired. Great technical skill is required to manufacture this compound, and the product is made at a temperature of 5° C. (41° F.). A slight change in the temperature will immediately congeal the viscous solution into a solid opaque mass, which cannot be used again and must be discarded. This process is known as the Viscose process by its original discoverers. It is by far the cheapest process now in common use. The coagulating solution used for this process is varied. Some workers use alkaline solutions, whereas others use acid solutions. These solutions are of varying degrees in concentrations. After the thread has been squirted through the spinnerette, it is treated with alkaline sulphides in order to dissolve out the sulphur (formed as the effect of the carbon disulphide and the other compounds used in the process). It is washed and dried in the usual manner as already described.

THE CUPROID PROCESS

Another interesting process utilizes the copper-ammonium oxide (Schweitzer's reagent) as the solvent for the cellulose. This latter compound can be made by the reaction of ammonia (in a closed vessel) on copper turnings, and through this solution is pumped a fresh and continuous supply of air; in time the copper will be found to be completely dissolved. Another process is to make a caustic soda solution, also a copper sulphate solution. The two are mixed, and ammonia is added to dissolve the precipitate first formed (copper hydroxide). The cellulose is dissolved in this solution. Acid coagulators are mainly used, the copper oxide in the thread is disposed of, washed and dried.

ACETATES

A mixture of acetic acid, acetic anhydride and sulphuric acid will dissolve cellulose. On the addition of water to this solution, cellulose acetate will precipitate out in the form of a fine white powder or flake-like form. This is next dried to dispose of the moisture, and when it is completely dried, it is dissolved in a solution of ethyl acetate, acetone, etc. Such solutions are forced through the spinnerettes into alcohol, which is used as the coagulator. It is finished in a similar manner to that already described.

In the place of acetic acid and acetic anhydride, formic acid may be used with good results. In fact, it is much cheaper than the former compound. Cellulose acetate or formate are both expensive procedures, and are not used commercially. The chief advantage of the product is that the threads are more or less incombustible. Furthermore, the cellulose can be brought into solution quickly; this is not the case with the other cellulose solvents.

The Amateur Magician

By JOSEPH H. KRAUS

(Continued from page 973)

did so, "I shall need a little more paper in order to start a fire," but before he had finished talking that candle was pouring forth an immense amount of paper. It actually tossed the paper ribbon free of the table over the floor, figuratively speaking, not literally so. "That is almost enough now, I believe," he stated when the paper had been heaped all around the table to a height of almost two feet. He removed the candle-stick from the table, again showing that there was no connection between it and the table. Replacing it he demanded more paper, and it poured forth another volume of the colored ribbon. The paper would stop at his command; it would start again when he so ordered, it continued to flow intermittently until the whole side of the library was massed high with it—until Hargrave himself could no longer wade through it toward the table, yet so rapidly did it issue, that no human hand could possibly have fed it.

Hargrave was a funny sight as he waded through the tangled mass, which, like so many snakes, was gripping his feet. He reached forward, picked up the candle-stick, and then walking toward me, handed it to me. I examined it. It was a neat, simple affair, only differing from the regular candle-stick by the fact that it was extremely slender. There was no opening in the top or the bottom, through which the paper could be made to exude. The bottom was perfectly flat, and the effect produced was without a doubt very spectacular.

Hargrave proceeded to explain the apparatus used. Extricating the table from the jumble of paper, he removed its lid, and there was the entire secret. A minute slot in the top of the table was all that could be seen from the outside, but beneath this slot, underneath the table top, was a relatively spacious compartment. Close up against the top of the table were a pair of rollers made of rather soft rubber, one of which was pressed by a small spring against its neighbor. The other was equipped with a two-inch pulley wheel, connected to a small motor in the table top. Wires led downward through the legs to points projecting from the bottom of two of the legs, which points made contact with metallic plates under the carpet. In addition to that a small rotary blower was directly connected to the electric motor for, as Hargrave explained, the paper ribbon had been in the habit of becoming clogged in the candle-stick, and compressed air was found necessary to force it out of the candle-stick, while at the same time it gave the ribbon the effect of flying out of the broken candle. The paper was placed in a compartment beneath this table in the usual coils, such as employed by magicians, except that the outer band of one piece of paper was securely fastened by means of glue to the inner edge of the roll immediately beneath it. In this way the eight or ten, fourteen-inch rolls of paper could be disposed of completely. It was easy to see that the moment the motor was started, the ribbon was forced up through the table due to the friction rollers which gripped and fed it. At the same time the blower operated, causing the ribbon to be waved about, the nozzle of the blower being adjacent to the slotted opening in the table top, but covered if desired by a small trap. Hargrave then grasped the candle-stick, introducing a long hat pin into the top and bottom, and pushed aside two shutters which exposed a long tubular opening extending through its center. I now saw the trick, or at least thought I did, but there were several things yet to be explained, namely, his ability to remove the candle holder from the table at any moment desired. This, I found, was very simple.

Hargrave merely turned off the current supply to the electric motor, and by pulling the holder across the table top severed the paper band, much the same as if he had used a pair of shears. The thinness of the candle-stick makes one suspect the table, at least it so affects one who is versed in magic technic, but when the candlestick is finally passed out for examination, the effect becomes more mystifying and puzzling. The shutters in the candle-stick operate on pivots and when it is tipped over to one side the shutters swing closed, and practically lock in that position; to replace them an effort is required. There are several different types of traps made for these closures, Hargrave showing me several styles, but in view of the fact that the reader undoubtedly has his own opinion with regard to how these should be designed, only one is given here.

This explained the operation of one of the candle holders quite thoroughly, but not the other, which I found to be far simpler than the one previously described, and which could be built by the average amateur at a lower cost than the first.

Essentially this consists of a fake candle, which is a hollow tube representing a candle and perforated in the back with several holes. A candle-stick is procured and drilled out, so as to house a solenoid 2½ inches long, and 1¼ inches external diameter. A copper tube is now procured, ½-inch internal diameter, and upon this No. 18 bell wire is wound, until the entire coil fits the hollowed-out portion of the candle-stick tightly. In this a long iron rod is placed, which will slide freely in the copper tube, upon the top of which rod a small plate is mounted holding a lit candle. When this device is shown, a small piece of candle is attached in the top of the fake, which is removed in the act of extinguishing the light, with the fingers; so small can this piece be that no difficulty will be found in palming it off. Wires connect to points in the base of the candle holder, thence to plates beneath the plush covering of the table, and down through the legs in the usual manner. Current to the solenoid will now cause the small piece of candle within the hollow fake to be propelled upward, due to the action of the solenoid on the iron core, which is attracted into the coil. The fake at the top of the table is so arranged that four points project around this top to prevent the candle from being propelled too high, as otherwise the increased size of the candle would immediately indicate to the audience that the device is merely a clever mechanical contrivance. For the extinguishing system, an ordinary single stroke electric bell in the base of the candle holder is attached to the spring held constrictor of a rubber tube. To the end of this rubber tube an inflated balloon is fixed with rubber bands.

A separate circuit to the bell from the twelve-volt storage battery, which is employed to operate this device, causes the constrictor of the rubber tube to open, permitting some of the air to escape out of the toy gas balloon. A copper tube bent at the top of the fake candle holder is lined up, so that a blast of air from it will cause the candle to be extinguished. In operating this feature, the control switch for the air is given a short sharp touch, closing the circuit momentarily. This is insufficient to cause the candle to go out, yet it will cause the flame of the same to flicker. This effect can be produced several times, after which the candle may be blown out. The toy balloon houses an amount of air great enough to blow out the candle even if it were lit several times.

Wind-Driven Electric Lighting Plant

By L. B. ROBBINS

(Continued from page 977)

procured, of generous size, similar in shape to the one illustrated. One lug must be drilled to bolt between the upper lugs of the clamp. The bottom lug is slender and should be twisted to lie against the bottom of the generator. It is screwed to the housing shell along the bottom and the end is also turned up at right angles, and screwed to one of the tapped holes in the front plate already provided. Then set the clamp and vane in position at the same time, and you are ready for the swivel. This is made from a heavy spindle hub taken from the front wheel of a motorcycle. Be sure the ball bearings are easy running and that there is no side play. Drill out four of the spoke holes so they will correspond with four similar holes in the bottom of the generator clamp. Also a fifth hole in the center of the clamp should be drilled to allow the end of the spindle to bolt to it. The detailed arrangement is shown in the sketch. The holes in the top end of the hub are tapped and then the hub is fastened to the clamp with four machine screws. The spindle should also be bolted to the inside of the clamp so that both the clamp and hub revolve as one on the spindle. Drill a hole in the center of a 2-inch pipe cap to which attach the other end of the spindle, allowing the hub to turn upon it. Screw the cap down solidly upon the end of a length of 2-inch pipe, arranged vertically in a flange which should be bolted to a block and stayed by three round iron stays as indicated. This is shown in the sketch. Be sure that the pipe is long enough to allow the propeller blades to revolve without interference. The cap may be further secured by a set-screw tapped into the side. This pipe standard, being directly connected to the generator, acts as the ground and a lead wire into the building can be connected beneath one of the flange bolts at the bottom. The other terminal at the top of the generator must be connected to a contact roller which travels about a metallic track. This is necessary because the generator revolves continuously about its axis, which would very quickly wind a lead wire up into a tight snarl about the standard and prevent the operation of the entire device.

First cut out a thick ring of fibre, hard rubber or some good weather-proof insulating material which will clamp securely about the pipe cap with set screws. The top surface should then be provided with a flat, circular brass track. Use flat-headed screws, countersunk to prevent interference with the roller. A lug should bend down at one point and connect to a binding post on one side of the fibre. The roller is simply a rotor from a Ford timer pivoted in a stiff metal arm about the shape and character indicated in the detail sketch. Fasten a block of insulating material to the bottom lug of the vane with screws and then screw the flat portion of the roller arm to the fibre, taking care that the two sets of screws do not come in contact with each other. The arm and roller should be so adjusted that the roller bears firmly upon the track, but clears the pipe cap and fastenings by a good margin. Much of this depends upon the tension of the roller spring. This arm can be made any shape desired, the cut is merely a suggestion. Connect the roller arm to the binding post on the top of the generator by a heavily insulated wire. With this arrangement no matter how much or in what direction the generator revolves the current generated passes through the roller into the track and out of the lead wire connected to the fibre ring. Several notches

(Continued on page 1004)

Wind-Driven Electric Lighting Plant

(*Continued from page* 1003)

around the inside of the fibre ring where it meets the pipe cap, may be advisable, to carry off any moisture which might cause short-circuiting between the track and the pipe cap. In any case, an oil cloth or rubber hood will greatly aid in keeping these parts dry during rainy or wet weather. Provide a high, unobstructed position on the roof or pole for the plant to operate. If it is desired to stop the generator at any time during high winds, a wire can be hooked into the tip of one blade of the propeller.

Set a cut-out in the line exactly as is done in the car wiring system and connect up to a 6-volt battery and as many lights as is needed. This cut-out is necessary to prevent the battery discharging back through the generator when the propeller is stopped or turning slowly. No more than four lamps should be used at one time, however, as the battery will be quickly run down. 32 C. P. bulbs can be used and good illumination will be realized at all times. An optional method of arranging the brushes is also given.

The Geometry of the Eye

By DR. ERNEST BADE

(*Continued from page* 964)

the flying insect in a normal direction. Three of these are generally developed and they stand in an upright equilateral triangle. When in flight, all three are equally illuminated, and at night the direction of flight is immediately changed when the rays of a lamp strike one of the ocelli. The body is then turned until all three of the simple eyes receive the same amount of light and the creature flies directly into the lamp.

The ocelli, although true eyes, are much restricted in their effectiveness, especially when only a few visual cells are present. Ocelli with many cells are generally only found in pairs. Then the pigmented capsule is open in different directions. In those creatures where the ocelli consist of only one optically active cell, many simple eyes are found, being then so scattered about that their axes lie in different directions, their number thus increasing their effectiveness. This is where the formation of the compound eye of arthropods, joint-footed creatures, begins. But even in some of the segmented worms as for instance, trachiomma, tubular ocelli, consisting of capsule or cavity with refractive media and retina, occur close together. Here it is possible that imperfect images of objects are formed. As the individual ocelli approach each other, the narrower does the field of vision become, and as these come in contact without overlapping, the sharper and more distinct will the image appear.

It is at this point that the interesting geometry of the eye becomes apparent. Round simple eyes, somewhat compressed, are still found in the oldest representatives of the arthropods, the horseshoe crab with its five living species, members of which flourished in the carboniferous period. Although the circular eyes are here quite close together, there is, of necessity, a comparatively large space between them which can not be utilized for sight. On compressing numerous individual eyes within a narrow field, an image can be seen. The total stimulus derived from each eye brings the image together like a mosaic pattern. It has not been said that the image is divided into lines, as is the case with the mosaic picture, for in reality, the compound eye will receive an impression and be able to give vision just as we obtain it with our two eyes.

In all these round and compressed ocelli which are also present in the silver fish (*lepsima*) and pill bug, a large portion of the area in which the eyes are situated can not be utilized, so that such a grouping is by no means rational. Progress in development occurs when they are still further compressed so that no vacant spaces are found. *Cambarus*, the fresh water crayfish, solved this problem in such a manner that the eyes became four-sided, each square being next to and above each other. This, undoubtedly, is economical, since the vacant spaces in the round eyes are here utilized. But since the perimeter of a square is always longer than that of a circle of equal area, the space available is far from being employed to its greatest possible extent. A change to the highest possible development of such compound eyes is attained by the majority of insects and the more highly developed crabs and lobsters where each facet has become hexagonal in shape. Here the problem is solved, for the largest possible number of eyes are here placed upon the smallest possible space, with the least possible quantity of material.

The greatest disadvantage of the compound eye when contrasted to an ocelli, is its low sensitiveness to light. The quantity of light entering the eye depends upon the size of the surface permitting the light to pass, that is its upper lens surface. In an ocelli this is much larger than in each individual facet of the compound eye which have not only become narrow, but also decreased in surface area.

The hemispherical form of many an insect's compound eye permits it to view a large part of the area around it. In the crabs and lobsters where the compound eyes are not so prominently curved, they are situated on elongated eminences which are movable in all directions and so enable the animal to look all around it. Still other modifications are possible. In *gyrinus*, the whirligig beetle common to our ponds, each compound eye is divided horizontally into two distinct parts by a comparatively noticeable membrane. This enables the creature not only to look into the water below it, but also above it as it whirls, with ever-increasing rapidity, along the surface of the water.

The eye of the vertebrates is so entirely different from that of the invertebrates, that it is completely isolated from them. There is no connecting link which bridges the gap from one to another. Although the vertebrates' eye is also found in small pimple-like form, it does not originate from the cells of the ectoderm, but from a lateral extension of part of the brain. It also differentiates itself from the former in build, structure and form. All these differences are found in the most primitive vertebrates as well as in the most highly organized.

In the chameleon the eyes are spherical, the retina being small and star-shaped. Both of the protruding eyes are movable and independent of each other. One may be turned forward and upward while the other is looking backward and downward.

It is interesting to mention that the earliest vertebrates, the amphibians and reptiles of prehistoric times, were provided with a third eye whose remnant can still be distinguished on living descendants of this group of animals. Even man has such an atrophied third eye. It is situated on top of the head, and, in the forerunners of the vertebrates, this eye undoubtedly played an important part. The still living lizard, *spenodon* or *hatteria*, a relic of ancient far-off days, has such a third eye.

Book Review

AUTOMOTIVE REPAIR. By J. C. Wright. Vol. II. Profusely illustrated. Hard covers, 5¾"x9¼". Published by John Wiley & Sons, Inc., New York City.

This book, written by the Director of the Federal Board for Vocational Education, is the second volume of a series devoted to repair jobs. The idea is to educate the returned soldiers, so that they can earn their living creditably for themselves and usefully for the country, but while it is presumably designed for their use, it is an admirable presentation of the subject, one which will be of interest to all mechanically disposed owners of automobiles, and certainly will be of great use to the progressive garage proprietor. It is liberally illustrated, and is written in very brief style. The greater part of the book is devoted to the description of more than fifty "jobs," with a list of questions following the specifications of materials and of operations for each "job." A very nice little section is devoted to the presentation of electricity, its theory and measurements of units, and a very suggestive section of less than four pages is devoted to starting-motor troubles. We would be pleased to see a more adequate index for so admirable a book.

YEAR BOOK OF THE AMERICAN PHARMACEUTICAL ASSOCIATION. Illustrated. Hard covers,, size 5¾"x9¼". Published by American Pharmaceutical Association, Chicago, Ill.

Photo-chemical and photo-tropical phenomena appear, and piezo electricity has a paragraph. These subjects our readers are familiar with, from their treatment in our columns. History and biography appear in its pages, and its other divisions include pharmacy, materia medica, drugs, plants, organic chemistry, and kindred subjects. We often allude in these columns to indexes. This book has a subject index in fine print and double column, occupying over thirty-six pages and a similar index of some eighteen pages of authors follows. We cannot commend this feature too highly.

Experimental Electro-Chemistry

By RAYMOND B. WAILES

(*Continued from page 976*)

lithium falls into the kerosene, which protects it from the air and moisture. The electrode should now be inserted again, and the current passed again as usual until the bath is depleted.

The potassium chloride is added to the lithium chloride to lower the melting point of the salt, and the lithium is, of course, contaminated with a slight amount of metallic potassium.

The current will develop heat itself, therefore the Bunsen burner should be turned down a trifle after the reaction begins. The lithium produced will take fire if it is dropped on water and the floating ball is held stationary on the surface, so that the heat of the reaction between it and the water becomes sufficient to ignite the lithium. The hydrogen gas being inflammable, will burn also.

AMMONIUM AMALGAM

Mercury, the only metal which is liquid at room temperature combines to form an alloy with many metals. Such an alloy with mercury as a constituent is called an *amalgam*. A drop of mercury rubbed on a gold ring or pin will cover it with a thin film of gold amalgam and make the ring as brittle as glass. The mercury can be removed by acid treatment or with the application of a burning match, the heat vaporizing the mercury.

Household ammonia is ammonia gas, NH_3, dissolved in water, along with impurities such as pyridine, carbonates, etc. The water solution of ammonia is more properly termed, ammonium hydroxide, for: $NH_3 + H_2O = NH_4OH$, i. e., ammonia gas, NH_3, dissolved in water, H_2O, produces (=) ammonium hydroxide, NH_4OH. The group NH_4 in the latter compound is called a *radicle*, here, the ammonium radicle. Radicles are not like elements, for they cannot exist alone and can not be isolated.

A peculiar property of the ammonium radicle, NH_4 is its combination with mercury to form ammonium amalgam. The amalgam can be prepared electrolytically.

A small layer of mercury is poured into a graduated cylinder (Fig. 4), and covered with a strong solution of ammonium sulphate in water. A well insulated wire runs down into the solution and makes contact at its lower bare end with the mercury in which it must be completely immersed. A carbon rod serves as the other electrode and this electrode must not touch the mercury.

On connecting the mercury electrode with the negative side of a storage battery and the other electrode to the positive side, the ammonium radicle will be attracted toward the negative mercury electrode, lose its positive electrical charge which it acquired when it ionized or dissolved in the water, and become ordinary ammonium, or the ammonium radicle. It immediately unites with the mercury, forming ammonium amalgam, which swell up into a peculiar spongy mass an gradually fills the graduated container. It cannot be preserved.

New Light Effects in the Theatre

By LUCIEN FOURNIER

(Continued from page 963)

the same country at night, the snow is less visible. Next comes in the third view the end of winter—there is no snow left. The fourth view represents spring, shown by the apparition of the leaves upon the trees. In the fifth view the trees are covered with their foliage and beautiful June helps the scene. In the sixth scene, flowers are shown in the meadows.

Thus on the screen different aspects of the country appear with any desired rapidity, with different aspects showing the same country in close liaison with the scenario of a ballet. The transformation takes place without the public realizing it. Three projectors, there being two groups of three lanterns each, making a total of six, are used to carry it out. When the first slide is projected on the screen from one of the lanterns, the second slide is placed in another, and both are projected simultaneously on the screen. A third and a fourth up to the sixth, follow each in its own lantern. So little by little the view changes without any break in the continuity. The spectators see Nature awakening from its slumbers, coming out in leaf and flower as if from a single projection. We now come to the fixed projections.

At the side of the two groups of three lanterns each, two, three or four separate lanterns are placed, which have lantern slides giving moving objects in the scenery, clouds driven by the wind, lightning flashes, apparitions of spirits, or the cavalcades of the Valkyres, as shown in our illustration. This set of colored views is no longer motionless; each of them shows a phase of motion, the galloping of horses, for example, seen in the Valkyres picture. These pictures are grouped up to the number of fifteen upon a disk, which is placed in front of one of the separate lanterns, and which turns once per second. It is a version of the cinematograph. When the projection is going on the speed of rotation of the disk, gives complete reproduction of a moving image on the retina, so that a true cavalcade is produced upon the screen. As the troupe of horses has to traverse the width of the curtain, and must not run without changing place, the lantern itself is pivoted and moved on a vertical axis and swung across the scene. The combined movements of the disk and of the lantern proper, give a perfect illusion in all its beauty of the cavalcade of the Valkyres.

This gives us the general principles of the new system of projected scenery, which is to be shown to audiences this winter in the Opera House at Monte Carlo. However little one may know of theatrical affairs, the importance of this innovation is perfectly obvious, and the material is evidently one needed for theatrical presentations.

It may seem impossible that so many combinations could be carried out practically, and that it would be impossible for any error to creep in, and the point is that the electricians charged with the operation of the lanterns are guided by the music of the orchestra. With them there is a technician who follows this music and tells them at every instant what changes to carry out, so that there is absolute synchronism between the representation of the actors and the changes of scenery, which changes are carried out with mathematical precision at determined moments.

So now, thanks to these magic lanterns, any kind of a hall or parlor can in a few hours be transferred into a true theatre, which will not be inferior to the most elaborate of the kind. A simple screen at the back, and to which can be added also cloth side scenes, a battery of lanterns, and a well supplied box of lantern slides supply all the needs. So we have reached the end of the immense scenes in painted canvas, which fill up all the present theatre stages and which need numerous personnel for their operation. Electricity with one blow has thrown down this house of cards.

The Latest in Color Harmony

By WILLIAM R. REINICKE

(*Continued from page 966*)

example that the problem is the selection of colors for a booklet cover to print on a yellow stock, which corresponds to yellow, tone 1: You place mask 1 upon yellow of the color keyboard, and the following combinations will be found; yellow, blue (major) and violet-red, or yellow, green-blue (minor) and violet-red.

Harmonies are formed upon the blends of neutrals, gray neutrals and blends, in exactly the same manner as upon the color keyboard. Mask 2 is applied to each band separately. The three colors showing through the three openings simultaneously, wherever it is placed upon the individual band, are in harmony. The band of neutrals is formed by over-lapping each color of the color keyboard with the seventh color following, which is the fifth of the diatonic scale. Thus red is overlapped with green-blue, red orange with blue, orange with blue-violet, etc.

Harmony is produced upon the color keyboard, bands of neutrals and blends and harmonized color scales by the application of one of the three masks supplied with the chart. The masks have three openings allowing for the exposure of only three colors at a time. The position of these openings is such that the three colors which show through when applied to the bands of color will always form harmonious combinations, no matter at what position in the sequence the masks are placed.

The center opening of mask 1, for chart A is equipped with a double opening shutter giving the choice of two colors which may be used as the second color of the combination. By sliding the shutters various tones of colors are exposed.

Mask 2, for chart B, can be used on either major or minor side.

Mask 3, for chart C, will give harmonious color combinations when No. 1 opening is placed on any of the color blocks except those marked 7.

When No. 1 opening of mask 3 is placed on a color block with square corners a major chord will result. Minor chords result when first opening is upon a rounded corner color block. Color blocks containing diagonal lines are never used through No. 1 opening of the mask.

SCIENCE SIFTINGS

A recently invented sea-scooter travels at thirty-five miles an hour and draws but five inches of water when slowed down. It carries six passengers, is non-sinkable and non-capsizable. It will be used for quick trips between Florida and the West Indies.

One of the largest telescopes in the world, with a five foot reflector, was recently completed at Cleveland for the Argentine National Observatory.

Bees recognize each other by the individual odor of the hive. When a bee returns home after a search for nectar, he is recognized by his odor and if because of long absence he loses the identifying odor, the guardians of the hive, thinking he is a stranger, fall upon him and bring his life to a tragic end.

How to Use Your Camera

By DR. ERNEST BADE

(Continued from page 978)

Other questions arise when pictures are taken in the mountains. Here the actinic or active rays are predominant, yet the amateur is only too often disappointed with the results of the desired pictures. Seen on the ground glass with a lens or normal focal length, a mighty mountain becomes an insignificant hill. Larger pictures are obtainable when working with the back pair of lenses of a double anastigmat, with a tele-photo lens, etc. For work at high elevations orthochromatic plates or films are to be preferred to all other types. The sensitiveness of the emulsion is only of secondary importance, for the far better lighting conditions in the mountains would influence the more sensitive emulsion adversely when over-exposed. Even in these orthochromatic plates the blue is very sensitive and to equalize this tendency, a yellow filter has its advantages but when, and where, and under what conditions it is advisable to use it, must be determined for each case and for each situation. When taking a picture of snow and hoarfrost, the yellow filter is always used, although everything may appear white on white.

The almost entirely white expanse of a snow landscape, and the brightness of the light, require a very short and quick exposure. When the yellow filter is used this exposure must be doubled or quadrupled according to the thickness and denseness of the filter. Snow on twigs and limbs of trees is only to be taken against a background of the sky when the sky is dark or deep blue so that the correct tone values are obtained with the filter, otherwise they must be taken against a dark wall. If the foreground is too monotonous, then a few footprints are made in the snow. This will break up the larger surfaces and lead the eye into the picture.

The contrasts of such snow scenes must not be heightened by the developer. They should be developed in a weak solution diluted with water. Then the imperceptible half tones and the delicate shadows are brought forth. The orthochromatic nonhalation plates or films are best adapted for such work.

CONCERNING CARBON RHEOSTATS

In the October issue of this journal, on page 571 in the article, New Filament Compression Rheostat, a statement was made to the effect that explosions in certain types of rheostats are not uncommon, reference being made to the carbon disc type rheostats. Mr. R. Fishback desires that we correct the impression which may erroneously be obtained by the reader interested in this article, stating in part: "Any ordinary person considers that an explosion or blow up is just exactly what the words imply. In the electrical sense, we consider the fusing of a wire or the fusing of a switch, or the burning out of a coil, as a break-down, which sometimes is incorrectly called a blow-up. It is of the same meaning as in the statement, that a fuse *blows*." Mr. Fishback continues, stating that he knows of cases where the compression rheostats made by the concern he represents, when subjected to overloads of 300% or 400% did not even become hot to the point of redness, whereas metal rheostats placed in the same circuits would *blow* or fuse.

If therefore, the reader has obtained the impression that the explosion resembles the bursting of a shell, the above statements will serve to correct that impression. Mr. Fishback enclosed some very interesting curves made on the Bradleystat, when experimented with by a Governmental bureau, in which a range between .8 and 1.05 amperes was accomplished by giving a Bradleystat less than one complete turn of the knob.

Scientists have discovered that the successful way to kill off rat pests is to kill only the females, liberating the males. The males when the sexual proportion is thrown out of balance, fight to the death and greatly assist in extermination.

The New Accelerator

By H. G. WELLS

(Continued from page 955)

power-buses. It was one of those hot, clear days that Folkestone sees so much of, every color incredibly bright and every outline hard. There was a breeze, of course, but not so much breeze as sufficed under these conditions to keep me cool and dry. I panted for mercy.

"I'm not walking fast, am I?" cried Gibberne, and slackened his pace to a quick march.

"You've been taking some of this stuff," I puffed.

"No," he said. "At the utmost a drop of water that stood in a beaker from which I had washed out the last traces of the stuff. I took some last night you know. But that is ancient history, now."

"And it goes twice?" I said, nearing his doorway in a grateful perspiration.

"It goes a thousand times, many thousand times," cried Gibberne, with a dramatic gesture, flinging open his Early English carved oak gate.

"Phew," said I, and followed him to the door.

"I don't know how many times it goes," he said, with his latch-key in his hand.

"And you ——"

"It throws all sorts of light on nervous physiology, it kicks the theory of vision into a perfectly new shape." . . . "Heaven knows how many thousand times. We'll try all that after. The thing is to try the stuff now."

"Try the stuff?" I said, as we went along the passage.

"Rather," said Gibberne, turning on me in his study. "There it is in that little green phial there. Unless you happen to be afraid."

I am a careful man by nature, and only theoretically adventurous. I *was* afraid. But on the other hand, there is pride.

"Well," I haggled. "You say you've tried it?"

"I've tried it," he said, "and I don't look hurt by it, do I? I don't even look livery and I *feel* ——"

I sat down. "Give me the potion," I said. "If the worst comes to the worst it will save having my hair cut, and that I think is one of the most hateful duties of a civilized man. How do you take the mixture?"

"With water," said Gibberne, whacking down a carafe.

He stood up in front of his desk and regarded me in his easy chair; his manner was suddenly affected by a touch of the Harley Street specialist. "It's rum stuff, you know," he said.

I made a gesture with my hand.

"I must warn you in the first place as soon as you've got it down to shut your eyes, and open them very cautiously in a minute or so's time. One still sees. The sense of vision is a question of length of vibration, consequently of frequency of impacts; but there's a kind of shock to the retina, a nasty giddy confusion just at the time, if the eyes are open. Keep 'em shut."

"Shut," I said. "Good!"

"And the next thing is, keep still. Don't begin to whack about. You may fetch something a nasty rap if you do. Remember you will be going several thousand times faster than you ever did before, heart, lungs, muscles, brain—everything—and you will hit hard without knowing it. You won't know it, you know. You'll feel just as you do now. Only everything in the world will seem to be going ever so many thousand times slower than it ever went before. That's what makes it so deuced queer."

"Lor'," I said. "And you mean - —"

"You'll see," said he, and took up a little measure. He glanced at the material on his desk. "Glasses," he said, "water. All here. Mustn't take too much for the first attempt."

The little phial glucked out its precious contents. "Don't forget what I told you," he said, turning the contents of the measure into a glass in the manner of an Italian waiter measuring whisky. "Sit with the eyes tightly shut and in absolute stillness for two minutes," he said. "Then you will hear me speak."

He added an inch or so of water to the little dose in each glass.

"By-the-by," he said, "don't put your glass down. Keep it in your hand and rest your hand on your knee. Yes—so, and now ——"

He raised his glass.

"The New Accelerator," I said.

"The New Accelerator," he answered, and we touched glasses and drank, and instantly I closed my eyes.

You know that blank non-existence into which one drops when one has taken "gas." For an indefinite interval it was like that. Then I heard Gibberne telling me to wake up, and I stirred and opened my eyes. There he stood as he had been standing, glass still in hand. It was empty, that was all the difference.

"Well?" said I.

"Nothing out of the way?"

"Nothing. A slight feeling of exhilaration, perhaps. Nothing more."

"Sounds?"

"Things are still," I said. "By Jove! Yes! They *are* still. Except the sort of faint pat, patter, like rain falling on different things. What is it?"

"Analyzed sounds," I think he said, but I am not sure. He glanced at the window. "Have you ever seen a curtain before a window fixed in that way before?"

I followed his eyes, and there was the end of the curtain, frozen, as it were, corner high, in the act of flapping briskly in the breeze.

"No," said I; "that's odd."

"And here," he said, and opened the hand that held the glass. Naturally I winced, expecting the glass to smash. But so far from smashing it did not even seem to stir; it hung in mid-air—motionless. "Roughly speaking," said Gibberne, "an object in these latitudes falls 16 feet in a second now. Only, you see, it hasn't been falling yet for the hundredth part of a second. That gives you some idea of the pace of my Accelerator." And he waved his hand round and round, over and under the slowly sinking glass. Finally he took it by the bottom, pulled it down, and placed it very carefully on the table. "Eh?" he said to me, and laughed.

"That seems all right," I said, and began very gingerly to raise myself from my chair. I felt perfectly well, very light and comfortable, and quite confident in my mind. I was going fast all over. My heart, for example, was beating a thousand times a second, but that caused me no discomfort at all. I looked out of the window. An immovable cyclist, head down and with a frozen puff of dust behind his driving-wheel, scorched to overtake a galloping *char-a-banc* that did not stir. I gaped in amazement at this incredible spectacle. "Gibberne," I cried, "how long will this confounded stuff last?"

"Heaven knows!" he answered. "Last time I took it I went to bed and slept it off. I tell you, I was frightened. It must have lasted some minutes, I think—it seemed like hours. But after a bit it slows down rather suddenly, I believe."

I was proud to observe that I did not feel frightened—I suppose because there were two of us.

"Why shouldn't we go out?" I asked.

"Why not?"

"They'll see us."

"Not they. Goodness, no! Why, we shall be going a thousand times faster than the quickest conjuring trick that was ever done. Come along! Which way shall we go? Window, or door?"

And out by the window we went.

Assuredly of all the strange experiences that I have ever had, or imagined, or read of other people having or imagining, that little raid I made with Gibberne on the Folkestone Leas, under the influence of the New Accelerator, was the strangest and maddest of all. We went out by his gate into the road, and there we made a minute examination of the statuesque passing traffic. The tops of the wheels and some of the legs of the horses of this *char-a-banc,* the end of the whip-lash and the lower jaw of the conductor—who was just beginning to yawn—were perceptibly in motion, but all the rest of the lumbering conveyance seemed still. And quite noiseless except for a faint rattling that came from one man's throat! And as parts of this frozen edifice there were a driver, you know, and a conductor, and eleven people! The effect as we walked about the thing began by being madly queer, and ended by being—disagreeable. There they were, people like ourselves and yet not like ourselves, frozen in careless attitudes, caught in mid-gesture A girl and a man smiled at one another, a leering smile that threatened to last for evermore; a woman in a floppy capelline rested her arm on the rail and stared at Gibberne's house with the unwinking stare of eternity; a man stroked his mustache like a figure of wax, and another stretched a tiresome stiff hand with extended fingers towards his loosened hat. We stared at them, we laughed at them, we made faces at them, and then a sort of disgust of them came upon us, and we turned away and walked around in front of the cyclist towards the Leas.

"Goodness!" cried Gibberne, suddenly; "look there!"

He pointed, and there at the tip of his finger and sliding down the air with wings flapping slowly and at the speed of an exceptionally languid snail—was a bee.

And so we came out upon the Leas. There the thing seemed madder than ever. The band was playing in the upper stand, though all the sound it made for us was a low-pitched, wheezy rattle, a sort of prolonged last sigh that passed at times into a sound like the slow, muffled ticking of some monstrous clock. Frozen people stood erect, strange, silent self-conscious-looking dummies hung unstably in mid-stride, promenading upon the grass. I passed close to a little poodle dog suspended in the act of leaping, and watched the slow movement of his legs as he sank to earth. "Lord, look *here!*" cried Gibberne, and we halted for a moment before a magnificent person in white faint-striped flannels, white shoes, and a Panama hat, who turned back to wink at two gaily dressed ladies he had passed. A wink, studied with such leisurely deliberation as we could afford, is an unattractive thing. It loses any quality of alert gaiety, and one remarks that the winking eye does not completely close, that under its drooping lid appears the lower edge of an eyeball and a little line of white. "Heaven give me memory," said I, "and I will never wink again."

"Or smile," said Gibberne, with his eye on the lady's answering teeth.

"It's infernally hot, somehow," said I. "Let's go slower."

"Oh, come along!" said Gibberne.

We picked our way among the bath-chairs in the path. Many of the people sitting in the chairs seemed almost natural in their passive poses, but the contorted scarlet of the bandsmen was not a restful thing to see. A purple-faced little gentleman was frozen in the midst of a violent struggle to refold his newspaper against the wind; there were many evidences that all these people in their sluggish way were exposed to a considerable breeze, a breeze that had no existence so far as our sensations went. We came out and walked a little way from the crowd, and turned and regarded it. To see all that multitude changed to a picture, smitten rigid, as it were, into the semblance of realistic wax, was impossibly wonderful It was absurd, of course; but it filled me with an irrational, an exultant sense of superior advantage. Consider the wonder of it! All that I had said, and thought, and done since the stuff had begun to work in my veins had happened, so far as those people, so far as the world in general went, in the twinkling of an eye. "The New Accelerator ——" I began, but Gibberne interrupted me.

"There's that infernal old woman!" he said.

"What old woman?"

"Lives next door to me," said Gibberne. Has a lapdog that yaps. Gods! The temptation is strong!"

There is something very boyish and impulsive about Gibberne at times. Before I could expostulate with him he had dashed forward, snatched the unfortunate animal out of visible existence, and was running violently with it towards the cliff of the Leas. It was most extraordinary. The little brute, you know, didn't bark or wriggle or make the slightest sign of vitality. It kept quite stiffly in an atitude of somnolent repose, and Gibberne held it by the neck. It was like running about with a dog of wood. "Gibberne," I cried, "put it down!" Then I said something else. "If you run like that, Gibberne," I cried, "you'll set your clothes on fire. Your linen trousers are going brown as it is!"

He clapped his hand on his thigh and stood hesitating on the verge. "Gibberne," I cried, coming up, "put it down. This heat is too much! It's our running so. Two or three miles a second! Friction of the air!"

"What?" he said, glancing at the dog.

"Friction of the air," I shouted. "Friction of the air. Going too fast. Like meteorites and things. Too hot. And, Gibberne! Gibberne! I'm all over pricking and a sort of perspiration. You can see people stirring slightly. I believe the stuff's working off! Put that dog down."

"Eh?" he said.

"It's working off," I repeated. "We're too hot and the stuff's working off! I'm wet through."

He started at me. Then at the band, the wheezy rattle of whose performance was certainly going faster. Then with a tremendous sweep of the arm he hurled the dog away from him and it went spinning upward, still inanimate, and hung at last over the grouped parasols of a knot of chattering people. Gibberne was gripping my elbow. "By Jove!" he cried. "I believe it is! A sort of hot pricking and—yes. That man's moving his pocket-handkerchief! Perceptibly. We must get out of this sharp."

But we could not get out of it sharply enough. Luckily, perhaps! For we might have run, and if we had run we should, I believe, have burst into flames. Almost certainly we should have burst into flames! You know we had neither of us thought of that. . . . But before we could even begin to run the action of the drug had ceased. It was the business of a minute fraction of a second. The effect of the New Accelerator passed like the drawing of a curtain, vanished in the movement of a hand. I heard Gibberne's voice in infinite alarm. "Sit down," he said, and flop, down upon the turf at the edge of the Leas I sat—scorching as I sat. There is a patch of burnt grass there still where I sat down. The whole stagnation seemed to wake up as I did so, the disarticulated vibration of the band rushed together into a blast of music, the promenaders put their feet down and walked their ways, the papers and flags began flapping, smiles passed into words, the winker finished his wink and went on his way complacently, and all the seated people moved and spoke.

The whole world had come alive again, was going as fast as we were, or rather we were going no faster than the rest of the world. It was like slowing down as one comes into a railway station. Everything seemed to spin round for a second or two, I had the most transient feeling of nausea, and that was all. And the little dog which had seemed to hang for a moment when the force of Gibberne's arm was expended fell with a swift acceleration clean through a lady's parasol!

That was the saving of us. Unless it was for one corpulent old gentleman in a bath-chair, who certainly did start at the sight of us and afterwards regarded us at intervals with a darkly suspicious eye, and finally, I believe, said something to his nurse about us, I doubt if a solitary person remarked our sudden appearance among them. Plop! We must have appeared abruptly. We ceased to smoulder almost at once, though the turf beneath me was uncomfortably hot. The attention of everyone, including even the Amusements' Association Band, which on this occasion, for the only time in its history, got out of tune, was arrested by the amazing fact, and the still more amazing yapping and uproar caused by the fact that a respectable, overfed lapdog sleeping quietly to the east of the bandstand should suddenly fall through the parasol of a lady on the west—in a slightly singed condition due to the extreme velocity of its movements through the air. In these absurd days, too, when we are all trying to be as psychic, and silly, and superstitious as possible! People got up and trod on other people, chairs were overturned, the Leas policeman ran. How the matter settled itself I do not know—we were much too anxious to disentangle ourselves from the affair and get out of range of the eye of the old gentleman in the bath-chair to make minute inquiries. As soon as we were sufficiently cool and sufficiently recovered from our giddiness and nausea and confusion of mind to do so we stood up and, skirting the crowd, directed our steps back along the road below the Metropole towards Gibberne's house. But amidst the din I heard very distinctly the gentleman who had been sitting beside the lady of the ruptured sunshade using quite unjustifiable threats and language to one of those chair-attendants who have "inspector" written on their caps. "If you didn't throw the dog," he said, "who *did?*"

The sudden return of movement and familiar noises, and our natural anxiety about ourselves (our clothes were still dreadfully hot, and the fronts of the thighs of Gibberne's white trousers were scorched a drabbish brown), prevented the minute observations I should have liked to make on all these things. Indeed, I really made no observations of any scientific value on that return. The bee, of course, had gone. I looked for that cyclist, but he was already out of sight as we came into the Upper Sandgate Road or hidden from us by traffic; the *char-a-banc*, however, with its people now all alive and stirring, was clattering along at a spanking pace almost abreast of the nearer church.

We noted, however, that the window-sill on which we had stepped in getting out of the house was slightly singed, and that the impressions of our feet on the gravel of the path were unusually deep.

So it was I had my first experience of the New Accelerator. Practically we had been running about and saying and doing all sorts of things in the space of a second or so of time. We had lived half an hour while the band had played, perhaps two bars.

But the effect it had upon us was that the whole world had stopped for our convenient inspection. Considering all things, and particularly considering our rashness in venturing out of the house, the experience might certainly have been much more disagreeable than it was. It showed, no doubt, that Gibberne has still much to learn before his preparation is a manageable convenience, but its practicability it certainly demonstrated beyond all cavil.

Since that adventure he has been steadily bringing its use under control, and I have several times, and without the slightest bad result, taken measured doses under his direction; though I must confess I have not yet ventured abroad again while under its influence. I may mention, for example, that this story has been written at one sitting and without interruption, except for the nibbling of some chocolate, by its means. I began at 6:25, and my watch is now very nearly at the minute past the half-hour. The convenience of securing a long, uninterrupted spell of work in the midst of a day full of engagements cannot be exaggerated. Gibberne is now working at the quantitative handling of his preparation, with especial reference to its distinctive effects upon different types of constitution. He then hopes to find a Retarder with which to dilute its present rather excessive potency. The Retarder will, of course, have an effect the reverse of the Accelerator's; used alone it should enable the patient to spread a few seconds over many hours of ordinary time, and so to maintain an apathetic inaction, a glacier-like absence of alacrity, amidst the most animated or irritating surroundings. The two things together must necessarily work an entire revolution in civilized existence. It is the beginning of our escape from that Time Garment of which Carlyle speaks. While this Accelerator will enable us to concentrate ourselves with tremendous impact upon any moment or occasion that demands our utmost sense and vigor, the Retarder will enable us to pass in passive tranquility through infinite hardship and tedium. Perhaps I am a little optimistic about the Retarder, which has indeed still to be discovered, but about the Accelerator there is no possible sort of doubt whatever. Its appearance upon the market in a convenient, controllable, and assimilable form is a matter of the next few months. It will be obtainable of all chemists and druggists, in small green bottles, at a high but, considering its extraordinary qualities, by no means excessive price. Gibberne's Nervous Accelerator it will be called, and he hopes to be able to supply it in three strengths: one in 200, one in 900, and one in 2,000, distinguished by yellow, pink, and white labels respectively.

No doubt its use renders a great number of very extraordinary things possible; for, of course, the most remarkable and, possibly, even criminal proceedings may be effected with impunity by thus dodging, as it were, into the interstices of time. Like all potent preparations it will be liable to abuse. We have, however, discussed this aspect of the question very thoroughly, and we have decided that this is purely a matter of medical jurisprudence and altogether outside our province. We shall manufacture and sell the Accelerator, and, as for the consequences—we shall see.

PEAT FOR FUEL

In these days of coal strikes and the high prices for coal, the question of using peat for fuel is receiving serious consideration. This material costs forty per cent less than coal and is an efficient fuel. Minnesota has the largest supply of peat in this country, but Virignia, with the Great Dismal Swamp, has a peat bed almost a thousand miles square. Peat can be burned in open grates, closed stoves, furnaces, ranges and all the ordinary variety of heating apparatus.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Recording an Idea

(682) G. Bessemer, Chicago, Ill., asks whether he can record an idea.

A. Apply for a patent and your statement will go on file. We would suggest that for priority claims, you protect yourself partially by following the method outlined in previous answers.

Tire Improvement

(683) John T. Bushby, Montreal, Canada, enters a suggestion for treating rubber of an automobile tire with carborundum, for increasing the life of tires and preventing skidding.

A. We are of the opinion that any attempt to introduce a hard substance, such as carborundum, into an ordinary tire, will not assist the wearing qualities of the tire; on the contrary, it would tend to permit these hard carborundum pieces to pass through the tire, eventually tearing into the inner tube. Neither do we hold that the tire would be any more resistant to wear, for the reason that the carborundum pieces would penetrate into the rubber, leaving a pure rubber surface full of holes. This action would cause the tire to present a smaller surface to the road, which surface being pitted, would absorb oil, and on wet days the skidding effect would be increased.

Advertising Device

(684) V. E. Bradley, San Antonio, Texas, asks whether a device for projecting advertisements on clouds, either natural or artificial, would be of value.

A. Some time ago we published an article, in which lantern slides from an ordinary stereopticon were projected upon clouds of steam, developed by a special steam generator. This device was the subject of a patent issued at that time. We do not know whether experiments on the same have actually been tried. Frankly, we doubt that such is the case. Nevertheless, such things are entirely possible and feasible. There is no reason why you could not conduct experiments along these lines, and perhaps patent certain machines to project advertising signs upon the clouds. Such devices are bound to attract a great deal of attention, and reap a fortune for the successful inventor. Unfortunately, the amount of light required and the difficulty of focusing, are great handicaps in natural cloud projecting devices. These would have to be overcome. The device should be automatic in action.

Power Wheel and Water Pump

(685) John Brown, Fremantle, Western Australia, describes a machine in the form of an overshot water wheel, which is to develop power and pump *some* of the water back into the reservoir, so that it would not empty rapidly.

A. You are by no means improving a water power system as the power which you are developing in your overshot water wheel is being completely used up by only partially pumping back some of the water which passes over the wheel. You are merely making an attempt at perpetual motion without going to the end of the circuit and conservatively state that you intend to pump only *some* of the water back.

There is no need for us to elaborate on the above statement.

Magneto Generator

(686) Durell Benedict, Fond du Lac, Wis., submits a sketch of a magnetic generator and desires our opinion on its patentability.

A. We would not suggest that you apply for a patent on your device, inasmuch as the idea is very old indeed. You can buy generators of the type you have described on the open market today, ranging in price from $5.00 to $25.00. Your design shows no radical departures from old methods nor any new features which would make it patentable

Radio Loud-Speaker

(687) Clifford R. Anderson, Cambridge, Ill., submits a sketch for a three-coil loud-talker of ingenious design, and requests our opinion of the same.

A. It is quite possible that the amplifier which you have designed will work, but it will do this only after extensive tests and experiments have been made upon same. We would suggest that before proceeding with a patent application, you build a model and give it a thorough trial, comparing it at the same time with other loud-talking devices now upon the market in cost, quality of tone, and strength of signals.

Telescope Mirrors

(688) Hyman Biegeliesen, New York City, suggests that a metallic casing be heated, then rotated, and covered with molten glass. In this way he expects to overcome the difficulties of making large reflectors for telescopes out of solid glass.

A. Your suggestion for making mirrors for the large telescopes is valueless, for the simple reason that a metallic casing rotated rapidly, then covered with molten glass, does not permit that glass to cool evenly along its entire surface. The consequence is that torsion bands will be produced, and in the end we may have a mass of spiral, or spun glass, exactly what we do not desire. Another undesirable feature is the varying degree of expansion and contraction, due to temperature changes, of the two substances employed in the construction. But why use glass at all? At the present time, right here in New York State, there is a concern manufacturing metallic mirrors for reflecting telescopes. The large metal casings are made with curved surfaces, which are installed in sections, subsequently polished and plated.

Auto Decarbonizing and Gas Saving System

(689) Albert Nichol, Los Angeles, Calif., sends us a pamphlet of an attachment for automobiles, which injects steam into the carburetor. He asks whether the claims in the pamphlet he forwards are true.

A. The water manifold device has of course some advantages, but the claims made for it in the pamphlets you have sent are entirely too broad to be taken without a grain of salt. Passing steam through the carburetor and thus into the engine, reduces carbon, and also increases the gasoline mileage, but it is quite absurd to assume that this mileage will be increased 50% or 25%, even in exceptional cases. Passing super-heated steam into a gas engine, the first claim which the concern makes, will not make a semi-steam engine of your gas engine, any more than causing smoke to ensue from a toy fire engine makes it a semi-fire engine. Of course their claim that it will increase compression, is partly true, because of the fact that the carbon deposit is decreased. The same holds true for their other twelve cla'ms, speaking solely from the carbonizing viewpoint. Their reasoning on the last page of this pamphlet is very far-fetched indeed, and need not even be considered. Taken all in all, the pamphlet is littered with a mass of nonsensical rubbish which no intelligent individual will consider for a moment. Your question evidenced a disbelief of the claims and demonstrated good judgment on your part.

Game

(690) Harold C. Brown, Athenia, N. J., asks whether a copyright will fully protect a game which he has invented.

A. The layout of your game should be copyrighted after the game has been arranged in its final finished form. Such copyright would not prevent other manufacturers from changing the game and subsequently manufacturing a similar product. We would suggest that in placing this device upon the market, you have the games built for yourself by some local manufacturer and then attempt to sell them through your own agency to the various toy shops in and about the greater cities. This is the best method in the end, it being sometimes successful, whereas attempting to interest manufacturers in placing a new product before the buying public is long, tedious, and fraught with many difficulties.

LIQUID LEAD

(691) C. Maynard, Kansas City, Mo., asks whether a formula for keeping pure lead in the liquid state constantly would be of any value. He asks whether he should patent the idea or keep it a secret.

A. It certainly would. You have given us very little information regarding this, however. Many uses could be put to a liquid of this nature, particularly if the liquifying factor could be removed without the addition of heat.

For instance, X-ray tubes could be coated with this metal. It could be employed to solder pipes together, and made to line containers now absolutely unprotected. We believe that such a metal would also materially assist in the building of batteries, in that the grids could be constructed more easily and at greatly reduced costs. No doubt the process can be patented.

Of course, when such a patent has once been granted on such a system, anyone could make molten lead for his own personal use, although this lead or the materials used to produce molten lead could not be employed on a commercial scale. If unpatented, the process remains a secret, except as far as yourself or assistants are concerned, and as long as it remains a secret, you maintain better control over your idea, but the moment this secret becomes public you have no recourse by means of the law to bring suit because others are using the method if the device was not previously patented.

UNIVERSAL EXPOSITION OF INVENTIONS AND PATENTS

In our December Number was a notice of the first Universal Exposition of Inventions and Patents to be held in Madison Square Garden, February 12-15. So general was the response from Inventors and Investors all over the world that it was decided to hold this Exposition in the largest Exhibition Hall in the World, the Grand Central Palace, in New York City, February 17 to 22—six days instead of four. Beginning on a Saturday, and being open Sunday and Washington's Birthday, it will give the busy worker, manufacturer or banker an unusual opportunity to attend without losing time from his business, and every effort will be made by the management to bring the inventor, manufacturer and investor together.

Realizing that the inventor had no means of finding the right manufacturers, and the manufacturer no way of finding the right inventor, this Exposition was decided on as a clearing house for both. The mornings will be given over entirely to bringing the man of ideas in direct contact with the capitalist and manufacturer. The new inventions on exhibition will be advertised and written up in the daily papers.

To further insure success each afternoon and evening, there will be a celebration in honor of great inventors: Edison, Bell, Westinghouse and others, each having his day.

A Giant Wind-Power Plant

(*Continued from page 958*)

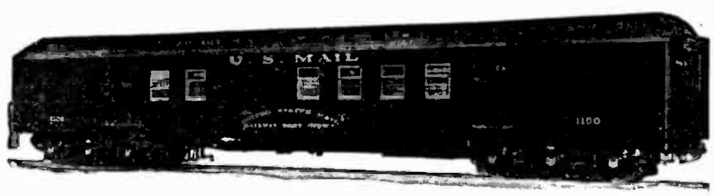
both speed and power when the wind velocity increases, thus causing the apparatus to lose efficiency, and if the speed of the shaft driven by the vanes, is lower than the optimum speed of the generator, then the generator again loses in efficiency. For this reason seven or more dynamos are arranged around one gear of the beveled type, as illustrated in the insert. These generators are compound wound, each overlaps in its power development the next higher rated machine As soon as one generator oversteps the limit of its performance, it is automatically switched out of the circuit, and the clutch of the next machine is thrown in, substituting the generator next largest in size or the reverse.

The switching in of these machines may also take place by actuating the clutches by hand. Thus with a wind velocity of from two to four miles per hour, a dynamo developing 1.4 to 11.2 horsepower, is employed. With the wind velocities of four to six miles per hour and the second generator in the current the proper one develops 11.2 to 37.8 horsepower. With wind velocities of six to eight miles per hour, the generator employed gives 37.8 to 89.6 horsepower, and if the velocity then increases from eight to ten miles, the next rated generator, 89.6 to 175 horsepower, is thrown into the circuit. At rates of ten to twelve miles per hour, the generator develops 175 to 301.5 horsepower. At twelve to fifteen miles, the generator develops 301.5 to 481 horsepower, and with increasing velocities up to eighteen miles per hour, a generator of 481 to 716 horsepower is employed. These figures are for the smaller machine illustrated in the background. It is evident that in the larger apparatus, shown in the foreground, the figures would more than triple these quoted.

The machine in the background is equipped with twenty wind motor wheels, each forty feet in diameter. The forward group utilizes the wind-power completely, or as nearly that as possible, while the rear line of motor wheels develop seventy-five per cent of the power absorbed by the forward wheels. In Germany, a rather level country, the Meteorological Institute of Berlin states that that country has no less than 8,439 wind hours of a velocity of from eight to ten miles per hour, which can be utilized, and in the entire year there are only 321 hours of calm weather, when power from storage batteries or a spare fuel motor would have to be employed.

Consequently the wind machine which we illustrated in the background in the accompanying illustration, supplies 1,924,056 horsepower hours every year, from which we subtract thirty per cent for transformation of the mechanical power to electrical energy, resulting in 1,345,000 horsepower hours or nearly 1,000,000 kilowatt hours. In particularly windy sections of the country with wind velocities of fifteen to eighteen hours per mile, the same wind motor will supply more than six million kilowatt hours, subtracting losses due to transmission, etc., but in the machines employing the three rows of motor wheels, the performance is tripled while building costs are increased by not quite one-third. The current may be stored up in storage batteries of the quick charging type, and then conveyed by means of wires to industrial plants, mills, factories, railroads, etc.

In Germany where this machine is attracting a great deal of interest, the cost figures for erecting the same are $70,000 for the smaller machine. This amount is based on



the present rate of exchange of German marks for American dollars. Consequently, it will not vary considerably regardless of how low the mark may drop, or how high it may rise. The operating expenses, including maintenance costs, attendance, interest and depreciation every year, amount to $11,400. A kilowatt hour at these figures would cost one and one-eighth cents; whereas in windy regions, the cost of a kilowatt hour would drop to less than one-fifth of a cent. These machines would naturally effect a great saving of coal. If one of them replaced each of the individual German electric works of which there are four hundred and eighty; seven and one-half million tons of coal would be saved every year (figures based on the year 1921). At the same time millions of dollars would be saved, power would be cheaper, and the coal could be left for future generations or for more pressing purposes.

The Secret of the Old Italian Violins

By DR. ALBERT NEUBURGER

(Continued from page 961)

which gave very superior musical results. Professor Koch felt that he was attaining his goal. His violins are constructed in the following way.

First of all the violins are made by skilled violin builders. Then the timbre of the instruments is examined and the procedure of treating them with filler depends upon the result of this examination. A violin that sounds very softly is treated differently from a violin that sounds hard. After the violin has been treated with the filler it is dried in the sun. This process may last for months. It is said that even years may be consumed. Amati, Stradivarius and Guarnerius lived in a sunnier clime and they undoubtedly obtained their results under the Italian sun more quickly than can be hoped for farther north. So, in the more northerly zone, we have to compensate for the lack of the Italian sun by our better chemical and physical knowledge, for the ultra-violet ray, it is found, can replace the sun in its action.

On an old Italian violin is seen the inscription, "It is useless to work without oil," and it is the filling which decides the result obtained. Another curious thing is that old instruments which are good in mechanical construction, can be improved by treatment with filler. From such instruments the old varnish has to be removed, and this may take five months, while the whole process to be gone through may consume sixteen months.

An experiment to avoid mistakes in rating the sound of the violins is thus described: The hearers are sitting in one room. In another room the Director of the Conservatory plays on different violins in succession. He is hidden from the hearers in the other room, and he himself does not know of whose make is each violin. Guarnerius, Nicolaus Amati, Hieronymus Amati, and three violins from Koch were so tested. After each trial a vote was taken on the qualities. Voting was secret. None of the hearers knew what was done. Finally the ratings were compared, so that eventually all of the violins received numbers indicating their merits. A Koch violin, dating from the year 1921 received the highest rating, 26 points; Nicolaus Amati with 19 points came next; after that the Hieronymus Amati, with 15, then another Koch violin with 13. It seemed certain, therfore, that Professor Koch had succeeded in solving the problem of the centuries!

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page 956*)

yacht," observed Doctor Hackensaw. "You will readily understand that in New York City I could not go openly into the water with my artificial gills, without attracting a crowd. Hence, I have constructed a special chamber in the hold of my yacht, from which I can enter the water at will. If you will come down with me, you shall have your first experience as a fish!"

Silas Rockett grinned rather sheepishly, but he was a good sport, and followed close to his conductor, who led him down several handsome stairways, and at last brought him into the special water-tight compartment from which the start was to be made.

"You spoke about the cold, Silas, so I'll show you how I manage to keep warm under water. All warm-blooded marine animals, like the seal, the whale, etc., are protected from the cold by a thick layer of blubber or fat. Instead of this I use a vacuum suit which answers the same purpose. The loss of heat is so slight that I could remain under water for days without experiencing the slightest discomfort from this source. There is nothing like a vacuum for preventing heat from passing. You will perceive that these suits are light, yet strong, and so flexible that one's movements are unimpeded. They are, in fact, more like some of the flexible chain armors used in the ancient days than like our modern stiff diving suits. And the clumsy helmet is replaced by a very light hood."

"Where are the gills?" asked Silas.

"They are in the soles of the shoes," replied the doctor. "You see," he explained, "in order to walk upright under water, the shoes must be the heaviest portion of the suit. Hence I enclose in one the motor that works the artificial gills, and in the other the motor that runs the propeller which enables me to swim through the water more rapidly than a fish."

"How about the engine to run the dynamo?"

"I use no engine. My power is received by wireless from New York power stations. I have also made diving suits provided with a buoy that floats on the surface of the ocean, and the action of the waves on the buoy runs my machinery. In case of emergency I can work both the gills and the propeller simultaneously by means of pedals like bicycle pedals. I can use either arms or legs, or both, for the work. This, of course, is for use only in case of an accident, or for special work during war-times."

"You can use the machine for war purposes?"

"Certainly. Indeed it is a most valuable adjunct to either the army or navy. A river, nowadays, is quite an obstacle to the advance of an army. But when I can send an army of men under water to blow up the enemy's bridges, boats, etc., or to excavate tunnels under water for the purpose of planting mines under the enemy's works, I have a great advantage."

"But the enemy can use nets, as they do with submarines."

"Not at all. A net in the river above their entrenchments, one below, and a connecting net between the two will suffice against a submarine, because the submarine is blind. But the diver under water can see the nets and avoid or force a passage through them. Then, too, the enemy can use bombs effectively against a dozen submarines, but it is an entirely different matter to bomb an army of a thousand men or more crossing the river under water at different places."

"How does the diver return to the surface when he wishes to?"

"I have followed the example of the fish. As you probably know, the lungs of a man are nothing but the developed bladder of a fish. This is one of the curious facts, so common in nature, of an organ originally designed for one purpose, being altered to serve for an entirely different purpose. The function of a fish's bladder is to enable it to rise or sink in the water at will. By expanding the bladder, the fish occupies more space in the water, hence is more buoyant, and rises to the surface. By expelling the air from the bladder, the fish becomes less buoyant, and sinks.

"I have used the same principle in my diving suit. My suit is provided with an elastic reservoir into which I can, at will, admit, under pressure, the air produced by the gills. When the reservoir is expanded, I rise, when contracted I sink. I can thus float or swim in the water at any desired depth. Similar reservoirs attached to the legs of my suit enable me to assume a horizontal or oblique position at will. For rapid travel I find an almost horizontal position is the best, and with my propeller going at full speed, I can make remarkable progress and easily outstrip any ordinary vessel. But enough of this talk. Put on your suit and we'll take a submarine stroll together and explore the bottom of the Hudson river."

With considerable misgivings, Silas Rockett donned the strange diving suit, the doctor closed the water-tight compartment and opened a faucet that soon filled the chamber with water. Then the doctor turned a handle and opened a slide in the side of the vessel, thus affording an entrance into the river. By means of a weighted rope-ladder let down from the ship, the two men had soon descended to the bottom of the Hudson and started walking down with the current, which, however, was very slight."

"Whew!" growled Silas, "pretty tough walking this!"

He did not expect any answer, but Doctor Hackensaw had had the forethought of providing his diving suits with telephones, so his answer came clear and strong:

"Yes, Silas," said he, "the walking *is* rough! But if you press button B, your air reservoir will fill and then we can try swimming for a change.

A moment later Silas perceived that the doctor had assumed a horizontal position, and with his propeller going, was making rapid progress through the water.

It did not take Silas long to follow suit, and he was surprised to find that he experienced no difficulty whatever in breathing; for, while a warm-blooded animal, like man, requires a great deal more air than a cold-blooded fish, yet the mechanical gills worked so much more rapidly than the natural gills of the fish that the air-supply was always ample.

"You're a wizard, doctor," cried Silas, "and not the least wonderful part of your invention is this wireless telephone with invisible apparatus."

Doctor Hackensaw laughed. "My '*wireless*' telephone," said he, "is nothing but a modification of a child's toy telephone made of two tin cans connected by a string. When *you* speak a metal plate on the exterior of your diving suit is set vibrating, and the vibrations are carried by the water to a receiving plate in *my* suit. Water is a better conductor of sound than air, and you see, the device works perfectly. But now, if you will turn on your searchlight, you will see that we are at the dock of one of the ocean liners, and you will understand how easy it would be to place a torpedo here and blow it to atoms. Well, it would be just as easy to blow up a dreadnaught. Nets and other devices would be powerless against me, for I can see them and guard against them. My approach can be noiseless, for I can lay in a supply of compressed air, and, stopping my propeller, I can walk or swim under water to the enemy's ship, which would be at my mercy. Unlike a submarine, I can remain for days or weeks under water. Drink and provisions for a week I can easily carry in a special knapsack on my back, or even in the suit itself. In the case of need I could eat oyster and shell-fish, which would, at a pinch, satisfy the cravings of both hunger and thirst. As for heat, there is a practical vacuum between the outer and inner linings of my suit, so that my bodily heat suffices to keep me comfortable. Strong braces between the two linings enable me to go down to great depths without my suit being crushed in."

It was a wonderful experience for the reporter as the two men-fish went shooting along through the water at a rapid pace, under the harbor traffic and were soon out in the ocean.

"Now, Silas," said the doctor, "I'm going to let you into a secret. There's a sunken vessel here, buried deep in the mud, and it must have been here over a hundred years. My impression is that it must have been a pirate vessel that sunk here after a successful cruise in the Spanish seas. I will show you what leads me to this belief."

So saying, the doctor steered downward and led the way to an old hulk lying on the ocean bottom, and there revealed to the astonished reporter a chest green with seaweed and deeply encrusted with marine growths. The chest had already been forced open and there were displayed to view a large number of gold and silver coins, tarnished with age, together with rings, bracelets and other jewels.

"There, Silas," said the doctor, "I don't know the laws about treasure trove, but there is certainly a small fortune there for someone!"

* * * * *

"Doctor, have you seen the news in today's paper?" cried Silas Rockett, bursting into the doctor's sanctum one morning. Three ocean liners sunk yesterday—all of them close to shore—one of them in New York harbor, just as it was leaving port."

"Yes, Silas," said Doctor Hackensaw gravely, "I know all about it; in fact, I knew beforehand that something of the sort was bound to happen, when I found that three of my diving suits with artificial gills were missing. The inference is only too plain that they must have been taken by a gang of criminals to further some nefarious scheme."

"Then you believe ——"

"I believe that whenever an ocean liner leaves port, and there is a probability of its containing a quantity of gold bullion or other such valuables on board, one of the villains, encased in one of my special diving suits, attaches himself in some way to the hull of the vessel, under water, and when he judges the time ripe, he explodes a number of small torpedoes that send the ship to the bottom. Luckily the loss of life is small, as the rogues merely wish to get the treasure."

"But cannot something be done to stop it?"

"I hope so, for though my artificial gills would have been a great boon to mankind if properly used, they become a terrible menace in the hands of criminals. These men are more dangerous to shipping than the greatest pirates that ever lived. But come along with me, Silas, and you can help me catch the ringleader."

"What are you going to do?"

"That would be telling, and I don't want to breathe a word of my plans to a living soul. But come with me and see for yourself."

Doctor Hackensaw led the way to his hangar, where were housed a number of aeroplanes of different styles and sizes. He seated himself in a closed machine of the oddest shape and placed Silas on the seat behind him.

"Ah," said Silas. "I understand. You're going to hunt for the fellow with an aeroplane. I suppose you expect to find him at the wreck in New York harbor."

Doctor Hackensaw shook his head. "No," said he. "The gold from that ship has already been taken away, so I have had to put new bait in the trap."

"What do you mean?"

"I mean that I have arranged that another large liner, loaded with gold, shall sail from New York to-day. If the fellow snaps at the bait, I shall have him."

"How so?"

"This machine, as you see, is closed, and is a submarine as well as an aeroplane. It can travel twice as fast under water as the man can. Then I have here two of my diving suits with artificial gills, with which we can follow him anywhere."

A moment later they had come in sight of the ocean liner which was steaming out to the harbor. Doctor Hackensaw stopped his engine, volplaned to the water and then started the propeller revolving again, the wings of the aeroplane folding up out of the way. The machine was now a submarine, with artificial gills working to renew the air supply.

A gyroscopic compass enabled the doctor to keep his course under water, and a special magnetic device enabled him to follow the transatlantic vessel with ease. He manoeuvered to get ahead of the vessel and then stopped. Next, both he and Silas hastily donned the diving suits and waited. A moment later the ocean liner passed over their heads, and there, sure enough, clinging to the hull, was a man in one of the doctor's suits, busily engaged fastening a torpedo to the bottom of the boat.

With a shout to Silas, the doctor was upon him, and though the villain struggled, he was soon at their mercy, for the doctor, with an instrument he had brought along, had perforated the diving suit, and the fellow was soon suffocated into helplessness. And when Silas and the doctor had finished removing the torpedoes from the ship, and returned to the spot, the man was drowned beyond hope of recovery.

* * * * *

That same night Doctor Hackensaw learned that two more members of the gang had been captured in the same way, and thus the three stolen diving suits were recovered. But after that, the doctor destroyed all but a dozen of the suits, and these he kept in a safe-deposit vault when not in use.

"It is astonishing," cried the doctor, "how every attempt to improve the condition of mankind, seems to bring added dangers. Even the railroad, the machinery in a factory and the automobile are all juggernauts and all demand the sacrifice of human life!"

NEW COMET DISCOVERED

A new comet has been discovered by the Astronomer Baade of Hamburg, Germany, according to a cable message recently received by the Harvard College observatory from Copenhagen.

The comet was reported to be in the Constellation Cygnus. It was much too faint to be seen without a telescope. During an interval of 3 days it was reported to have increased in brightness from magnitude 115 to magnitude 9.

Honorable Mention Awards in the $300.00 Simplest Radiophone Receiver Contest.

(*Continued from page* 983)

end of the bolt solder a cat-whisker as shown. This completes the detector.

Now mount three brass machine screws for binding posts as shown, and make connections as given in the hook-up. The aerial lead is fastened to a strip of copper of such thickness that its end will just fit into the slots in the connection posts. Another strip of the same thickness is soldered to a 13-inch piece of flexible wire, the other end of which is connected to the cat-whisker side of the detector.

The set is tuned by placing the two contact strips in various ones of the connection posts until the signals are heard loudest. It will also be necessary to adjust the detector, which may be done by means of a buzzer test, or after once having mastered the tuning of the set, by listening for a certain station which the operator knows is transmitting.

Third Honorable Mention to Miss Elizabeth C. King.

This set was built and designed by a girl who, up to six months before making it, knew nothing whatsoever of radio.

To build one similar to it, obtain a piece of hard rubber or fibre tubing 1¼ inches in diameter by 1¼ inches long. One end of this tubing should be closed. Also obtain a hard rubber disc which will just fit the end of this tube, and a wooden spool about ⅞ of an inch in diameter. Into one end of the spool force a plug of tinfoil well packed in. With this should also be forced in one end a quantity of No. 30 SCC wire. Wind the spool full of this wire, and allow one end to project out about 8 inches to provide a connection.

Now drop a piece of sensitive silicon down into the center of the spool, and fasten to the open end the hard rubber disc by means of a machine screw passing through a brass strip as shown. There should also be another hole in this brass strip directly over the center of the spool. Into this hole another machine screw is screwed and is used for adjusting the detector, which is semi-permanent.

Over the secondary winding which was just completed on the spool, place a tube of paraffin paper. On this tube wind six layers of wire, bringing out a tap at every layer. These taps are fastened to six machine screws which are placed around the base of the shell as shown. After winding this coil, coat it with paraffin and slip it off from the secondary. Place it within the shell and fasten by means of more wax.

The entire set is hooked up with a telephone receiver, aerial, and ground as shown. The ground connection is fastened to a clip which makes contact with the various machine screws in order to tune the apparatus.

To use this set the detector is first adjusted by turning the screw projecting from the top of the secondary slightly so as to find a sensitive point on the crystal, and by varying the position of the clip on the primary.

This set works very well, and when used in New York City brought in signals from the nearby broadcasting stations very loud and clear.

SUNLIGHT FOR TUBERCULOSIS

Recent experiments show that the sunlight has remarkable curative properties for tuberculosis and other forms of disease. The sunlight must be applied direct, and not through window glass, to get the best results.

Radio for the Beginner

By ARMSTRONG PERRY

(Continued from page 990)

his own call letters occasionally, on the same principle that a lonesome cow lows until answered by some other bovine who feels inclined to respond. No reflection on either the radio amateur or the cow is intended—that is the way of Nature.

After five minutes or so another amateur comes back at him in a tone that, compared with his, is like Ruysdale's voice as compared with McCormack's. Out at sea when they hear one of those bass notes the operators say: "There's a Limie," meaning a "lime-juicer" or British operator. For some reason the Britishers often prefer a low note, but the Yanks say it is because they are too lazy to adjust their apparatus to get a high, clear, musical note. I believe it is largely a matter of taste. The two amateurs chat back and forth until a third breaks in. One of the first two explains that the third wants to put a message through to a more distant station and says he is going to keep still and give him a chance.

Then church begins at the Church of the Covenant, which was one of the pioneers in broadcasting its services for the benefit of those who cannot get to the meeting house. I hear the pastor's well-known and well-beloved voice, the choir and the congregation. Sitting in the front row is one of those old gentlemen, gray, a little bald and somewhat deaf, who sing loudly, often off the key, and usually half a measure or so behind the organ. I can see him almost as plainly as though I were there. I'll wager there is a white beard on that face, that he thinks of dead grandchildren as he sings of heaven.

Right in the midst of the prayer the first amateur opens up again. He stopped his work to give the long-distance transmitter a chance, but the church—what has that got to do with amateur radio? The amateur's license to transmit is signed by Uncle Sam, and it does not say that he shall keep quiet while the parson prays.

Now if I were a beginner and I had bought an outfit in order to hear the church services I would get all het up about this. I would write to the Government, as some do who are interfered with, and demand that radio amateurs and their transmitters be banished from the air forever. But having encountered this condition before and being interested in all that is happening in the ether, I listen to the prayer with one ear and catch the drift of the amateur's message with the other.

Presently the sermon begins and I find it of real interest. The amateur's interference, coming in on his 200-meter wave, and that of NAA, the Navy station, which I know will break in at 11.55 on 2,650 meters per schedule, are enough to prevent my concentrating on what I want to hear. So at the end of my "funnel" I attach a "colander" or, as we call it in radio, a single-circuit tuner. Like the kitchen utensil that lets through the pulp for the marmalade without passing the skins of the fruit, it keeps out most of the waves except those that are approximately 360 meters long, the wave-length prescribed by Government regulation for broadcasting stations such as that at the church.

But when 11.55 arrives, NAA comes in. If I were a beginner I would lay that to the amateurs, too. A lot of listeners do blame the amateurs for all interference, though a large proportion of it comes from Government and commercial stations. I have learned, however, that NAA uses tremendous power and therefore forces its long waves into my receiver as I might jam the fruit skins through the colander if I put my weight behind a potato masher.

What I need is a sieve, something that will let through only the frequency that I am after and keep out all others. So I set aside the single-circuit tuner and attach one with a primary and secondary circuit, a variocoupler, variometers and several condensers. The wave to which it is adjusted comes through sharp as a needle, bringing in whatever of music, voice or code it may be carrying. Turning any knob a quarter of a degree shuts out one station and brings in another. All other waves, even the heavy swells from NAA, fade away before reaching my ear. At last I have exclusiveness and am satisfied.

But it is a lonesome business, sitting solitary in my den listening all by myself to something happening where sociable people congregate. With a twist of the wrist I get down to the amateur's wave, 200 meters. A station more powerful than those I heard first comes booming in, calling "1's" 400 miles to the northeast in New England and "9's" as far to the west. They answer and I realize that the "brass pounder," the key man, the amateur radio telegrapher, finds a joy in individual communication, that the rest of us miss. Most of their messages seem unimportant, except that when you are trying to see how far you can throw a ball it is necessary to have a ball to throw. Once in a while a real message goes across, such a message as you might find on the files of the Postal Telegraph Company or the Western Union, but most of them are real inquiries as to whether the sender was heard and how he sounded, and was his wave about right.

The signal strength of the local amateur causes me to wonder what he is doing to folks who are using less selective tuners. I change to a single-circuit tuner with an electron tube detector and two stages of audio-frequency amplification. This is the type most commonly used by folks who want to use radio, not study it. I hear the amateur nearly all the way around the dials. Can't get rid of him. He and the church are inextricably mixed, though each is unconscious of the other. Having schooled myself to concentrate on what I want I can listen to the sermon and ignore the amateur or vice versa, but from meeting many "novices" as the technical amateur insists we who only listen must be called, I know that a lot of religious people who are attending church by radio are saying unchurchly things.

Having heard Congressmen and other influential citizens who are not radio amateurs discuss such matters, I make up my mind that either the amateur and his brother jammers will have to find some way to pursue their hobby without getting in the way of superior numbers of citizens or they will be like Abner Day, who never yielded his right of way; who knew he was right so he went right along, and is just as dead as though he'd been wrong. To be sure these amateurs have licenses issued by our Government which give them the right to transmit so long as they keep within the law. No hours are specified. The law and his license forbid him to willfully or maliciously interfere with any other radio communication. Such interference is punishable by a heavy fine and imprisonment. The law states that the working of the radio stations shall be organized as far as possible in such manner as not to disturb the service of other radio stations. It holds that interference caused by certain tests is "willful" when no "listening in" precautions are taken to avoid it. But broadcasting is newer than individual message service and the amateur who keeps down to his legal wave-length and power output is not likely to be fined or imprisoned under present interpretations of the law even if complaints are made.

But licenses expire and laws are changed. A while ago an Eighteenth Amendment was applied to our Constitution which changed a lot of things. If I take up brass pounding, and I expect to some day, it will be with the expectation of either keeping out of the way of listeners-in or of doing what I did next.

Just before the afternoon service I learned that there were two old people in the house who had never heard anything via radio. I hooked up the loud speaker. The horn was downstairs where they were, connected with my other apparatus by long wires. As soon as I heard WDM, through the phones, announcing that the service was about to begin, I shoved in the loud-speaker plug and the organ of the church filled our big house with music.

Peeping over the balcony rail I saw the old couple tiptoe to a position right before the horn and sit down. All through the prelude, the announcements, the prayer, the offertory, the sermon, the benediction, they sat there reverently, whispering such comments as they had to make. Then they came up to my den to find out how it all happened. If I had wanted to, I could have cut loose after that with a one-kilowatt rotary spark transmitter and banged away the rest of the night as far as our household was concerned. No one in the house would have kicked. If all the amateurs in town had a privilege similar to mine once a week or oftener, a request from them to the public for quiet air for important tests would be granted as a matter of course any time, provided the reasons were clearly explained so that the public understood.

Selectivity is a great principle. It applies not only to radio but to matrimony and all human relationships. We are all different and we select different things. That is fundamental and is not a reason for the radio amateur to look down with contempt upon the beginner who chooses to buy a single-circuit tuner nor for the user of the aforesaid tuner to look down upon the man who likes to specialize on long-distance messages. It is unfortunate for the boy who has shown that he has no special aptitude in technical pastimes to follow the lead of the technical radio amateur, for he will only make a nuisance of himself and accomplish nothing. It is equally unfortunate for folks who merely listen-in with a radio set for the sake of amusement to complain of a boy who has earned his money for the parts, built his radio set, and who, if he is encouraged, may build upon the foundation laid by such men as Hertz, Marconi, Fleming, DeForest, Armstrong, Dubilier, Sarnoff, Weagant, Pupin and Steinmetz, apparatus and organizations that will advance civilization a hundred years inside of a decade.

Selectivity, if it is to be intelligently accomplished, must depend upon a knowledge of the things from which the selection is made. The beginner who selects a radio receiver, no matter how simple, so long as it will bring in something, and who listens carefully and thoughtfully day after day with a view to learning something and making progress, may become either a technical radio amateur or merely one of the majority who use radio with increasing efficiency to bring to their homes music, lectures, sermons and other food for the mind and soul. In either case, if he is fair-minded and generous, he will never lack a sympathetic understanding of the other amateur's ambitions and problems.

Listen—
Everybody!

The Whole Room Hears With the

DICTOGRAPH
Radio LOUD SPEAKER

The radio loud speaker that was worth while waiting for—the supreme gift of radio engineering—the *perfect* instrument *for the home*. Now a *whole roomful* can hear every part of the program, word for word, note for note, clearly and distinctly. No extra batteries required—you simply plug in and listen. Absolute freedom from distortion and mechanical noise. Made and guaranteed by the manufacturers of the world's famous Dictograph products—the "Acousticon" for the Deaf, the Detective Dictograph and the Dictograph System of Loud Speaking Telephones.

Volume production to meet heavy demand permits us to offer this wonderful instrument, complete with 5-foot flexible cord, at the amazingly low price of $20 (instead of $25). Ask your dealer to let you hear it today.

DICTOGRAPH PRODUCTS CORPORATION
220 West 42d Street Suite 1305 New York City
Branches in All Principal Cities

$20

The Standard of the World

A beautiful instrument. Bell horn of highly burnished spun copper. Cabinet of solid ebony-finished hardwood, mounted on rubber knobs. Black enamel die cast tone arm; nickel trimmings. Complete with 5-foot flexible cord. No extra batteries required.

Dealers: Order through your jobber or write direct for names of authorized Dictograph distributors.

The RADIOGEM

(Patents Pending)

$1 Receiving Set—The Simplest Radio Outfit Made—Yet as Practical as the Most Expensive!

You need know absolutely nothing about wireless to operate and enjoy the RADIOGEM. It is so sturdy, so simply constructed that it is small wonder radio *engineers who have tested* it have pronounced the RADIOGEM a brilliant achievement. The RADIOGEM is a crystal radio receiving set for everyone at a price anyone can afford.

Why The RADIOGEM Can Be Sold For Only $1

Here's the secret: The RADIOGEM Construction eliminates all unnecessary trimmings, cabinets and the like, which do not play any part in the operation of a set. You receive the RADIOGEM unassembled, together with a clearly written instruction book, which shows you how to quickly and easily construct the set, using only your hands and a scissor. The outfit comprises all the necessary wire, contact points, detector mineral, tube on which to wind the coil, etc., etc. The instruction book explains simply and completely the principles of radio and its graphic illustrations make the assembling of the RADIOGEM real fun. Remember the RADIOGEM is a proven, practical radio receiving set and will do anything the most expensive crystal set will do.

The RADIOGEM is the Prize Winner of the Age

Out of hundreds of radio models submitted recently in a great nation-wide contest, radio engineers, the judges, unanimously chose the RADIOGEM as the winner—the simplest radio-receiving set made! And the RADIOGEM costs you nothing to operate; no form of local electricity is required.

DEALERS The RADIOGEM is the wonder item of the radio age. It is storming the country, for the RADIOGEM'S price is so low everyone is able to buy one. Write immediately for full particulars before that shop across the street beats you to it.

Receives up to 20 Miles

The RADIOGEM CORPORATION
42-S HUDSON STREET
NEW YORK CITY

Hear the programs of the Broadcasting Stations on the RADIOGEM

$1
Without Phone or Aerial

Small Current—Big Job!

CARE IN SELECTING YOUR "B" BATTERY CURES A WHOLE FLOCK OF STATIC TROUBLES

A lot of radio bugs are missing a good bet when they fail to give the proper attention to the "B" Battery that supplies current to the plate circuit of the vacuum tube. In a good many cases—and this applies to the seasoned enthusiast as well as the newest novice in the ranks—it is wrongly set down that since this current is so exceedingly small it cannot be very important.

Nothing could more completely misrepresent the facts. True enough, the current supplied by the "B" Battery to the plate circuit is small—but it is precisely for that reason that even the slightest variations or disturbances are to be so carefully avoided.

In thinking of "B" Batteries keep this in mind: The current from these batteries go directly into the fine windings of the coils of your phones. Therefore, even the slightest disturbance or unbalancing of the battery is translated directly into noise.

Obviously the reason for carefully soldered connections, loop aerials, short leads and the elimination of useless wires is to do away with *noise* just as far as possible. The same reason should dictate the careful selection of "B" Batteries. It hardly pays to go to a great deal of trouble in taking the usual steps to eliminate static unless you also pick out a battery that is free from the hissing, sputtering and frying noises that are so often confused with static and that in common with static noises are multiplied six or seven times with each stage of amplification.

A "B" Battery that is completely in accord with the efforts of manufacturers of sets to do away with static disturbances is known as the Willard "B" Battery. This battery consists of a group of twelve glass-jar cells, assembled in oak cases and connected with heavy burned-on connectors. Due to the distance between jars electrical leakage from one jar to the next is practically impossible. As each of the cells has Willard Threaded Rubber Insulation between the plates there is no opportunity for leakage from plate to plate.

It is said by those who have carefully examined the construction of the Willard Radio "B" Battery that, in addition to its ability to give results without distracting noises, it will last—if not a lifetime—at least such a long period that it will show a material money saving long before it begins to exhibit even the slightest sign of age.—*Advertisement.*

Motion Pictures Via Radio

By JOSEPH H. KRAUS

(*Continued from page 982*)

transparency, move from the top downwardly. Each mirror face will in its movement reflect through the slot in the opaque screen the entire picture or image shown on the transparency, the image itself being reflected as a continuous succession of transversely divided parallel areas, beginning with the top portion of the image and passing down to the bottom. Consequently, each mirror face of the rotating prism causes the entire image to be reflected against the banks of selenium cells, once during each revolution of each prism. The strength of illumination of any point on the transparency has its effect upon the selenium cells once during the passage of each face of the prism before the transparency, the degree of illumination producing varying degrees of conductivity on the selenium cell. The method of connecting the individual selenium cells into amplifier circuits of the regenerative type is illustrated in Fig. 3. The cell is connected between the grid and the filament of the vacuum tube. This tube is provided with a supplemental grid, the hook-up being illustrated. The plate circuit passes through a variable resistance in series with the field of a high frequency alternator, the alternator itself being connected to the primary of a transformer, the secondary of which is placed across the aerial and ground with a series condenser in the circuit. As many antennae of different wave lengths as there are selenium cells are employed in this transmitting system, although it is possible that one antenna with different inductances in the circuit of the same will be employed.

In Fig. 4 the receiving circuit is illustrated. In this a bank of electro-magnets are connected across the secondaries of transformers. Each of these electro-magnets is provided with an armature, on which is mounted a small mirror disposed at a slight angle from the vertical, in order to reflect the light of a mercury vapor lamp, illustrated in Fig. 5. As is evident in Fig. 6, all these electro-magnets are arranged in a line in a position occupied in the transmitting circuit by the selenium cells. The light from the mercury vapor lamp is transmitted to the mirrors on the improvised relays, which if not energized reflect the light to the opaque screen. When fully energized, the light is transmitted directly through the slit in the screen to a revolving prism mirror, and thence projected upon a transparency. If the relay is only slightly energized, only a small portion of the light is reflected through the slit. The mirror rotated at the receiving end in synchronism with the transmitting mirror, causes the picture to be rebuilt on the screen. The synchronizing of the receiving device is not difficult to accomplish, because, as the picture is being transmitted, the speed of the motor at the receiving end may be varied until the composite picture is completely reproduced. An interrupter may be inserted into the receiving circuit, so as to reduce the frequency of variation of the current. If the image at the transmitting end has motion, then the image at the receiving end will likewise be reproduced in full motion.

The pneumatic shaving brush is a new invention. Why does not someone get out a vacuum razor to remove the lather and beard?

By the use of the saccharimeter, thereby correcting the grading of sugars, government experts increased the custom receipts $350,000 in five years.

New and Odd Uses for Audion Amplifiers

By H. WINFIELD SECOR

(Continued from page 985)

illustrated or told about in previous issues of this journal. A valuable device embodying the use of a V. T. amplifier of one or two stages is an *exploring-coil* trouble locator, for use about automobiles and electric machinery in general. The use of a V. T. amplifier, together with a loop aerial on a moving motor truck, for locating broken insulators on high-tension lines, was described sometime ago in this magazine. The device in mind at present is a smaller edition of this trouble locator, one that could be carried in the tool box of the electrician or machinist. Cracked or missing spark-plugs could be quickly located with this device, as well as short-circuits and other troubles in dynamos and motors while in operation.

An Amphibious Battle Tank

By A. P. PECK

(Continued from page 962)

of over 100 feet and then turned around and descended.

As it reached the water's edge, it was stopped, and the propellers were affixed to the longitudinal shafts provided for that purpose. These shafts have square ends which fit into square holes in the propellers, which are fastened securely to the shafts by means of nuts. The machine was then run into the water, the caterpillars assisting the procedure until the propellers were submerged. The tractor then crossed the river in 45 minutes, bucking a strong ebb-tide; the river at this point being nearly two miles wide.

The various accompanying photographs give an excellent idea of the design and construction of this tank, and the diagram shows how the wheels and propellers of such a tank are readily controlled. When the vehicle has been running on level ground without the caterpillars attached, and rough ground is encountered, the steering wheel is locked in place, so that all the wheels are in line, and the caterpillar treads are attached. From this point on all the steering is done by means of one lever which controls gears speeding up and slowing down one of the caterpillar treads. The machine is so designed that it can be turned within its length merely by stopping one of the caterpillars and allowing the other to travel on. When the tank enters the water, another lever is brought into play which transfers the power from the shafts of the back wheels to the propeller shafts. Now, as in the case of the caterpillar treads, the steering is also accomplished by driving one propeller faster or slower than the other.

When on land, the exhaust from the gasoline motor escapes at the rear of the body. However, when the tank enters the water, provision is made for shifting the exhaust pipes, so that the burnt gases leave through the top of the body in the rear of the driver's compartment. In this way, even quite high waves cannot interfere with the proper action of this important part of the motor.

This tank is capable of being used in field work and carrying a crew of ten men together with ammunition and supplies.

The United States Government has purchased Mr. Christie's patents on this new tank and will commence manufacturing the same in the near future.

A Thousand and One Formulas

By S. Gernsback

A Laboratory Hand Book for the Experimenter and for Everyone who wishes to "do things."

A Book brimful with very important and priceless information.

The recipes and formulas are classified in such a manner as to be available quickly, without long research.

Invaluable for Students, Engineers, Physicians, Experimenters, etc.

Here are some of the chapter headings:

Cements and Glues; Composition of All Kinds; Glass and Glassworking; Inks; Leather Polishes; Metal-craft; Perfumery, Soaps and Extracts; Photography; Blue Print and other Paper; Plating; Pyrotechny; Polishes and Stains; Varnishes and Paints; Various Cleaning Formulas; Wood-craft; Chemical Laboratory Hints and Experiments; Mechanical Laboratory Hints and Experiments; Electrical Laboratory Hints and Experiments.

There are a score of tables and hundreds of illustrations and Diagrams.

It contains 160 pages. The paper has been specially selected to stand rough handling in laboratories.

Size, 6 x 9 inches.

Cloth bound in Vellum de Luxe, stiff covers, hand-sewed, gold stamped, each $1.75

This Wonderful Volume of Forumlas—You Should Have It In Your Home

Every Radio Enthusiast Should Have *These* Books:

Wireless Course in 20 Lessons

By S. Gernsback, A. Lescarboura and H. W. Secor, E.E. (11th Edition)

A Course that tells you everything you wish to know about "wireless," starting lesson No. 1 by explaining the Principles of Electricity. By simple, easy stages, this wonderful Course takes you into "Wireless" by the use of simple language so skillfully used that you understand every word. There is a lesson devoted to Theory and Mathematics. The last lesson is devoted to a history of Wireless.

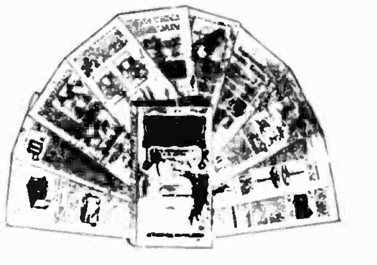
This Course has been considerably revised in order that it meet many important changes which have occurred in Radio Telegraphy and Telephony within recent years.

Size of book is 7 x 10¾ inches, 160 pages, 350 **illustrations, 30 tables.**

Cloth bound in Vellum de Luxe, stiff covers, hand-sewed, gold stamped, each $1.75

Same book, limp binding, colored cover $0.75

Experimental Electricity Course in 20 Lessons



By S. Gernsback and H. W. Secor, E.E.

Every phase of experimental electricity is treated comprehensively in plain English. New Experiments are described and explained and nearly every application of Electricity in modern life is given in simple language.

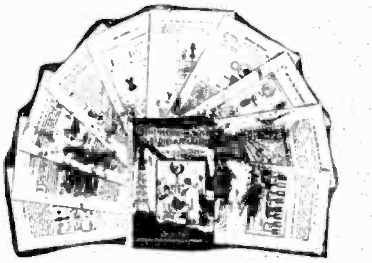
A masterpiece. Explains every electrical device from a push button and bell to the biggest generator made. **Worth its weight in gold** for the man who wishes to know about electricity, and to the experimenter it is still more valuable because of its many facts, tables, etc.

The Best Electrical Text-Book on the Market. Size of Book is 6 x 9 inches.

The book contains 128 pages, and more than 400 illustrations.

Cloth bound, stiff covers, hand-sewed, green and black stamped, each $1.25

The How and Why of Radio Apparatus



By H. W. Secor, E.E.

This newest book on radio matters fills a distinct gap in wireless literature. While the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general.

A very broad field has been covered by the author, giving a great amount of information not found in other text-books. If you are engaged in any branch of the Radio or allied arts you will surely need this latest contribution to radio literature.

This newest of Radio Work has 160 pages, 6 x 9 inches. Hundreds of illustrations and tables.

Cloth bound in Vellum de Luxe, stiff covers, hand-sewed, gold stamped, each $1.75

You'll Need These Three "Little Wonder" Radio Books:

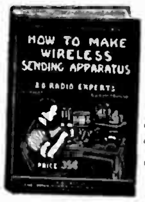
How to Make Wireless Receiving Apparatus

The 20 radio constructors who wrote the book know how articles should be made from simple materials.

Only modern apparatus is described, such as Receiving set without aerial or ground, magnetic detector, wireless relay, wireless lecture set, etc., etc. Book has 100 pages, each 5 x 7 inches, 90 illustrations, many full pages, paper bound, in two colors.

Price 35 Cents

How to Make Wireless Sending Apparatus



Contains information on how to make 30 different pieces of wireless sending apparatus from materials easily obtained.

Tells How to Make an Experimental Arc Set, Speaking Arc, Quenched Gap, ¼ K. W. Transformer, Oscillation Transformer, Photo Phone, etc., etc.

Book has 100 pages (size, 7 x 5 inches), 88 illustrations, paper cover printed in two colors.

Price 35 Cents

Design and Construction of Audion Amplifying Transformers

Radio and Audio Frequency Type

This book will be of great interest to all radio amateurs. The transformers have never before been described in print. The possessor of vacuum tubes cannot afford to do without this book. It will enable him to build the necessary amplifying transformers very readily. The book is printed on good paper and has an attractive cover in two colors. Paper bound. Size, 5 inches by 7 inches. Contains many illustrations, diagrams and working data.

Price 25 Cents

DEALERS—Ask for wholesale discount

EXPERIMENTER PUBLISHING CO., Inc. : 53 Park Place, New York

A New Bullet-Proof Vest

(Continued from page 968)

glance off is that it penetrates the fabric, leaving a hole only as large as itself, and then flattens against the steel plate. Of course, when it flattens, it becomes larger, and therefore cannot bounce back through the small hole which it makes in the fabric.

These four strips, that is, two of steel and two of fabric, are sewed up in a pocket of cloth, and several of these pockets are sewed together in such a way that they overlap each other half way. Each section, composed of several pockets sewed together, is then covered with a layer of rubberized cloth, which makes it impossible for the steel strips to rust, inasmuch as moisture cannot reach them. The vest being absolutely rust proof, there is no chance for deterioration.

These sections are now fitted together, the whole is enclosed in another covering, which contains pockets, and the entire outfit looks and fits like an ordinary vest.

The vest weighs only 12½ pounds complete, that is front, back and side shields, and the front only weighs five pounds.

The vest is particularly adapted to bank messengers and cashiers, and to policemen who are assigned to beats in dangerous neighborhoods.

In actual firing test it was found that when two bullets from a Colt .38 calibre police revolver were fired, so that one hit on top of the other, the first steel strip was split, but the second one was just dented. Since there are four strips protecting the body at every point, it is obvious that the vest affords absolute protection to all vital parts of the body. The armor will also stop a steel-jacketed Colt .45 calibre automatic bullet.

The editors can testify to the efficiency of this vest, as one of them saw an actual demonstration in which two .38 calibre revolver shots were fired, and neither of them did more than dent the two plates in the top layer. The accompanying illustration shows the effect of one of these shots, and also shows very well the size of the hole made in the metallized fabric as compared with the bullet after it is flattened.

The makers claim that in spite of the terrific impact of the modern high-power revolver or automatic pistol bullet, either lead or steel jacketed, the wearer receives a jar that is hardly noticeable, and he is left thoroughly able to defend himself, even though the weapon is fired at close range.

This vest has been tested by the Police Department of the City of New York, who found it perfectly satisfactory.

How Much Gold Has Been Mined

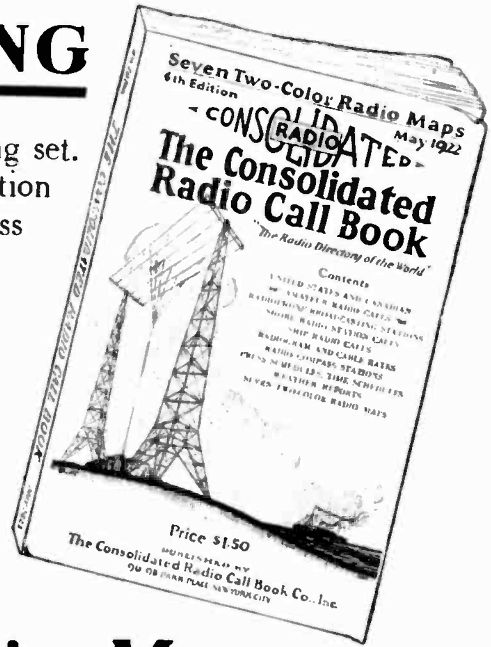
By CHARLES NEVERS HOLMES

(Continued from page 947)

second in production. In 1920, the United States produced about 2,476,000 ounces, which had a value of over $51,000,000. What our world's production was, before the discovery of America, is difficult to estimate. An approximate calculation would be one-third of what was produced after 1492. Now, according to statistics respecting the amount of gold mined from the year 1493 to 1922, men have dug out of the earth, during somewhat more than four centuries, approximately 900,000,000 ounces of fine gold. If we add to this amount all that was mined previous to the year 1493—about 300,000,000 ounces—we obtain our World's total production. This would approximate 1,200,000,000 ounces of fine gold. Compared with this, our Earth has produced about 17,000,000,000 ounces of fine silver.

KNOW WHO IS SENDING

Get twice the pleasure and usefulness out of your receiving set. Look up the name and location of any ship or land station whose messages you pick up—learn the name and address of that amateur whose sending set you just heard.



4th Edition of the

CONSOLIDATED RADIO CALL BOOK

In a new large size—280 pages—88 more valuable pages than the 3rd Edition and featuring

7 Two-Color Radio Maps

Five of them are Continental Maps showing all stations throughout the world handling commercial traffic, with their calls; one showing the amateur radio districts of the United States and the principal radiophone broadcasting stations with their calls; and a map of the United States Weather Forecast Zones. Seven wonderful, two-color radio maps with a wealth of information that will give you a great deal of pleasure and knowledge.

Every Amateur Call in the U. S. and Canada Is Listed Besides Other Valuable Information Contained in This New Book

All Amateur Radio Calls of the United States and Canada; Every Vessel, Coast Station, and Radio-Compass Station in the World; Radiophone Broadcasting Stations of the United States; Every High-Power Station in the World; Special Land Stations of the United States; Time Signals, Hydrographic and Weather Reports of the United States and Principal Foreign Countries; International Abbreviations; Assignment of International Calls; Press Schedules; Radiogram Rates; Cable Rates; International Morse Code and Continental Signals; and Complete General Information covering Distress Calls, International Safety Signal, Use of 800-Meter Wave Length, Amendments and Changes in Various Governmental Regulations, How to Determine Charges on Radiograms. Free Medical Advice by Radio to Vessels, and much other useful information.

And every vessel and land station in the world is represented and listed alphabetically, according both as to name of vessel or land station, and to call letters.

The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. And the New Radiophone Broadcast Section is particularly complete and gives all available information concerning calls, wave lengths, PROGRAMS, etc.

$1.50 Prepaid

The third edition of 10,000 copies was exhausted in two weeks. The fourth edition is selling just as quickly. Don't wait until it is all gone. Order at once, either direct from us or from your favorite dealer.

Published by

Consolidated Radio Call Book Co., Inc.

96-98 Park Place, New York City

Great 40-page Supplement FREE to all who have the 4th Edition Call Book

As a special service to the readers of the Fourth Edition of the Radio Call Book, we have printed, at great expense, a 40-page supplement containing the latest amateur radio calls of both the United States and Canada, and other calls issued very recently. It is absolutely free to all those who write for it, provided you have bought a copy of the fourth edition of the Consolidated Radio Call Book. This wonderful supplement brings the call book up to the very last moment and on account of the many changes that have taken place and which are fully covered by this supplement, every radio amateur or professional is urged to send for his free copy of this supplement today.

World's Largest Photo on Mountain

By CARL TAYLOR

(*Continued from page 948*)

because the canvas would not lie close enough to the rock and sometimes slipped out of place.

As a first attempt a shed was built at the foot of the mountain and the figures of the principal group outlined on a glass plate in a small window, as they were to be carved. By looking through this window from the inside of the cabin, you could see how the figures would look on the mountain.

Mr. Borglum's idea was to look through the window and by means of telephone direct workmen on the mountain. This plan was abandoned.

Then, the next best plan hit upon was to do the carving at night, projecting the pictures on the mountain by means of a powerful lamp. This may yet be resorted to if the plan of printing the picture fails, for the money has been raised to complete the project and Mr. Borglum has announced that he intends to give the remainder of his life to accomplishing the task.

"By early spring, I expect to have a picture printed on the face of the mountain," Mr. Borglum said in an interview recently in Atlanta, "and by the middle of the summer I expect to have the carving of General Lee far enough along so that it will be plainly discernible from the base. I am through with waiting. The plan for the memorial was conceived before the World War. That war of necessity halted operations, and it has been delayed since by indifference. Now I intend to wait no longer, but to push it along until it is completed and stands out as the greatest monument on earth.

"The memorial is to represent the mobilization of the Confederate Forces, preparatory to going into battle.

"All branches of the army, infantry, cavalry, artillery, will be shown marching across the face of the mountainside. A group of Confederate leaders will be seen in the foreground reviewing these troops. This group will include Lee, Davis, Stonewall Jackson, Johnson, Beauregard, Stewart, Gordon and Wheeler, all noted leaders in the Lost Cause.

"The figures of Lee and Davis will be the largest of the Confederate chieftains. The distance from the top of General Lee's hat to his charger's fetlock will be 82 feet, while the entire figure will be 30 feet long.

"It is my plan to carve the figures of Lee and Davis first, a work that will cost $100,000; then I will proceed with others in the main group, and after that I will set about carving the army marching to war. When completed, the project will be 700 feet long, and standing out in bold carving against the smooth side of this giant monolith, it will be stupendous—the most magnificent tribute ever paid by any people anywhere to the soldiers who fought and died for a cause they held sacred.

"The memorial as I plan it will take its place with the wonders of the world. The carvings of the single figures will dwarf any statues in the world, while the effect of an entire army marching across the mountain will be magnificent. It will be greater than the Lion of Lucerne, the Sphinx and Pyramids of Egypt, the Colossus of Rhodes or other world famous works."

Stone Mountain is situated sixteen miles east of Atlanta. It is a one mile path from the base to the summit on the approachable side, and it is 900 feet high on its unscalable side.

The actual work of carving the memorial will be done by Mr. Borglum, from a steel scaffold lowered from the top. Scaffolding already has been installed as far as possible, and Mr. Borglum has laid out stakes where the principal figures are to be carved. Other famous sculptors will assist him in his work.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the April issue must reach us not later than February 20.

The Circulation of Science and Invention is over 160,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 53 Park Place, New York City, N. Y.

Advertising Service

For quick results use direct mail advertising. Letters, folders, campaigns. Free suggestions. Wilson, 247 William St., East Orange, N. J.

Aeronautics

Boys build three foot model aeroplane at small cost. Write Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

Agents Wanted

Only one sale a day means $200 per month! Five sales, $1,000 per month! Marvelous new adding machine. Retails $15. Work equals $350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five-year guarantee. Offices, stores, factories, garages, buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. W., Grand Rapids, Mich.

Sell "Amenz" Shirts—best looking, biggest value. Manufacturer to wearer. Made to order or from stock. Splendid profits. Write for business winning plan. Menzin Shirt Co., 3863-H Third Ave., New York.

Agents, $60 to $200 a Week. Free Samples. Gold Sign Letters for Store and Office Windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 433Z N. Clark St., Chicago.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

Agents. Big Profits. Selling Wunrub Polish, for Furniture, Woodwork, Automobiles, etc. Cleans and Polishes. Write for Big Free Offer. Fritch's Laboratories, 312-D, North Carpenter, Chicago.

Write and learn how to start profitable business without capital or experience. Silvering mirrors, refinishing auto headlights, tableware, plating. Outfit furnished. International Laboratories, Dept. 25, 309 Fifth Ave., New York.

Agents—200% Profit. Wonderful Little Article. Something new; sells like wildfire. Carry right in pocket. Write at once for free sample. Albert Mills, Manager, 7944 American Building, Cincinnati, Ohio.

Agents—$15 a day—Easy, quick Sales—Free Auto—Big weekly bonus—$1.50 premium Free to every customer. Simply show our Beautiful, 7-piece, Solid Aluminum Handle Cutlery Set. Appeals instantly. We deliver and collect. Pay daily. New Era Mfg. Co., 803 Madison St., Dept. 88A, Chicago.

Agents—Best seller: Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold. It vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., Dept. 601, Philadelphia, Pa.

Wanted—District Purchasing Agents. National Instrument Co., 4718 North Hamilton, Chicago.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Ambitious Men, write today for attractive proposition, selling subscriptions to America's most popular automobile and sportsman's magazines. Quick Sales. Big profits. Pleasant work. Digest Pub. Co., 9541 Butler Bldg., Cincinnati.

Agents Wanted in Every City to sell standard Radio apparatus on a liberal commission basis. A few stocking agencies open to reliable parties. Delfelco, 12 Meeting St. Pawtucket, R. I.

27,000 Records guaranteed with one Everplay phonograph needle, new, different; cannot injure records; $10.00 daily easy. Free sample to workers. Everplay, Desk 27, McClurge Bldg., Chicago.

Agents—Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Earn big money fast applying gold initials to autos. Every owner buys—$1.35 profit on $1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 19, East Orange, N. J.

Automobile Free to Tailoring Agents: Make $75.00 a week and up and get an automobile free taking orders for our fine tailored-to-measure suits. Big assortment of All-Wool-Fabrics all at the one low price of $29.75. Every order pays you big cash profit in advance. We supply finest selling outfit and give an automobile free to every man who qualifies. Write quick for startling offer. Dept. 518, Park Tailoring Company, Chicago, Ill.

World's fastest agent's seller; 300% profit. Needed in every home and store. Establish permanent business. Premier Mfg. Company, 819 E. Grand Blvd., Detroit, Mich.

300 per cent. Profit: Selling Kleanrite Magic Clothes Washing Compound. Sells, 25c; Profit, 18c. Sample free. Bestever Products Co., 1941-W Irving Park, Chicago.

Big money made silvering mirrors, plating and refinishing metalware, autos, chandeliers, headlights. Outfits furnished. N. Decie Laboratories, 1133 Broadway, New York.

Agents Wanted (Continued)

We wish representatives in every community to secure subscriptions for Science and Invention, Radio News, and Practical Electrics. This is a wonderful opportunity for Amateur Radio Enthusiasts to make big money quickly. Write Experimenter Publishing Co., Inc., 53 Park Pl., New York City.

Housewives Buy Harper's invention on sight. New business. No Competition. Ten-Use Set is combination of ten indispensable household necessities. $7.50 to $30.00 a day easily. Write for Free trial offer. Harper Brush Works, 112 A Street, Fairfield, Iowa.

Free Booklet. Start little Mail Order Business. Pier, Dept. 30A, 74 Cortlandt St., New York.

Radio Agents Wanted for Rusonite Multipoint Crystal Detector and Gold supersensitive Catwhisker. Well advertised. Rusonite Products Corporation, 15 Park Row, New York.

Live Agents make $10 Day selling Eureka Strainer and Splash preventer for every water faucet. Takes on sight. Widely advertised and known. Get details today. A J. Seed Filter Co., 73 Franklin, New York.

Free. Formula Catalog. Laboratories, Boylston Bldg., Chicago.

Tremendous Opportunity for ambitious agents. The indispensable, rapid selling Speedy Dish Washer. Price $3.50. No competition. No investment. Easy selling plan. Convenient sample. Commission daily. Make application today—exclusive territory. Shepperd-Luth Mfg. Co., 16K Hudson St., New York.

Agents—Cost $5.00, your profit $89.50 transferring monograms on autos, trunks, bags, furniture, etc. No experience, no license. Write for free samples. Transfer Monogram Co., Inc., 10 Orchard St., Dept. 153, Newark, N. J.

Make $25 to $50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 27, Philadelphia, Pa.

57 miles per gallon made with new patented gasoline Vaporizer. Write for particulars. Vaporizer Co., Bukwana, S. Dak.

Agents. Sell Wolverine Laundry Soap. A wonderful repeater and good profit maker. Free automobile to hustlers. Wolverine Soap Co., Dept. B8, Grand Rapids, Mich.

$5 to $15 Daily Easy—Introducing New Style Guaranteed Hosiery. Must wear or replaced free. No capital or experience required. Just show samples, write orders. Your pay in advance. We deliver and Collect. Elegant outfit furnished all colors and grades, including silks—wool and heathers. Mac-O-Chee Mills Co., Desk 2812, Cincinnati, Ohio.

"Big Profits"—$250.00 to $300.00 a month—selling high-grade Leather Fan Belts and Belting to Auto Accessory Dealers and Garages. Full time only. Write Monarch Belting Co., 1270 Ontario St., Cleveland, Ohio.

American-Made Toys

Manufacturers on large scale, also homeworkers, wanted to manufacture Metal Toys and Novelties. Millions needed of Barking Dogs, Wag-Tail Pups, Wild Animals, Automobiles, Indians, Cow-Boys, Baseball Players, Cannons, Toy Soldiers, Crowing Roosters, Statues of Liberty, Miniature castings of Capital, Bathing Girl Souvenirs and others. Unlimited possibilities. Guaranteed Casting forms furnished manufacturers at cost price from $5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high prices for finished goods. Cash on Delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Rd., New York.

Automobiles—Automobile Supplies

Automobile Owners, garagemen, mechanics, send today for free copy of this month's issue. It contains helpful instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages, illustrated. Send for free copy today. Automobile Digest, 541 Butler Bldg., Cincinnati.

Blue Prints, Automobile AArmature connecting diagrams 1922 Edition. Charles Chittenden, B3024 Matthews, Kansas City, Mo.

Correspondence Courses

Dollars Saved. Used correspondence courses of all kinds sold, rented and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

Duplicating Devices

"Modern" Duplicators save Time, Labor and Money. Gets Business. Reproduces Typewritten or penned letters, Drawings, Lessons, Music, Menus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints two per minute. Special Sale On. 30 Days' Free Trial. $2.25 up. Booklet Free. B. J. Durkin-Reeves Co., Pittsburgh, Pa.

Books

Applied Psychology explains your latent powers and how to create Health and Prosperity. Our members receive Instruction Course, consultation privileges, vocational guidance and our magazine. Common-Sense Psychological Club, 155 E. Ontario, Chicago.

Perpetual Motion, by Percy Verance. A history of the efforts to discover same from earliest days to the present, together with a scientific discussion regarding the possibility of its ultimate achievement. Profusely illustrated, 357 pages. Price postpaid, $2.00. The Enlightenment Specialty Co., 305 Fourth St., Edwardsville, Ill.

Read Captain Gillett's book, "Six Years with the Texas Rangers." A true story of the world's most famous body of mounted police. Learn how these marvelous men cleared the Texas frontier of Indians and desperadoes. Not overdrawn. 332 pages, illustrated. $2.50 prepaid. Descriptive folder free. J. B. Gillette, Marfa, Texas.

Books for Sale on Occultism—Mysticism—Theosophy—Mental Science—Advanced Thot—Sex Secrets—Seership—Clairvoyance—Crystal Gazing—Numerology—Astrology—Yogi-Hermetic and Rosicrucian Philosophy—List Free. The Grail Press—Desk B, 712 G St., N. E., Washington, D. C.

Sexological Literature, the most extensive. Catalogue sent on request from the Original Book League, S. I. 5 Columbus Circle, New York.

Gleanings of a Mystic. By Max Heindel. New information regarding Initiation. What It Is and Is Not, and many other fine points never before presented in this form. 200 pages. Cloth bound, $2.00 post free. Ready about Dec. 15th. Rosicrucian Fellowship, Box 17, Oceanside, Cal.

"Vibrations," Sounds, Lights, Colors, Radio Cold Lights, Auras, illustrated. Literature Free. Stevens Publishers, 242 Powell Street, San Francisco, Calif.

Diseases and Their Innate Healer. Book 50 cents. Arthur Stevens, Wauseon, Ohio.

300 Book Bargains on Occulism, Mind-reading, Spiritualism, Clairvoyance, Hypnotism, Astrology, Self-Culture, Drugless-Healing, Sex Secrets, Popular Fiction. Catalog 2c. C. E. Winegar, Pub., West Fort Ann, N. Y.

Hypnotism—Astounds, Controls others, 25 easy lessons, $1; "Mindreading" (any distance), 30c. Science Institute, SE1014 Belmont, Chicago.

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparatus are described in this book and the illustrations and descriptions are so clear nad simple that no trouble will be experienced in making the instruments. Paper covered, 35c postpaid. Experimenter Publishing Co., Book Dept. 53 Park Place, New York City.

How to Make Wireless Sending Apparatus. 100 pages—88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" htan any other book we know of. Paper bound, 35c postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E. E. A course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c. postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

The How and Why of Radio Apparatus, by H. W. Secor, E. E. This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathemathics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general. A very broad field has been covered by the author, at the same time giving a great deal of information not found in other text books. If you are engaged in any branch of the Radio or allied arts at all you will surely need this latest contribution to radio literature, which is destined to be found on every radio man's book shelf before long. A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text: The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark Gaps; Radio-Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Decremeter; Antenna Construction; The Calculation and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book. This newest of Radio Works, cloth bound in Vellum de Luxe, Gold stamped and Hand Sewed, has 160 pages. Size of book, 6x9 inches. The How and Why of Radio Apparatus. Postpaid, $1.75. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Business Opportunities

Good Income spare time refinishing chandeliers, brass beds, autos by new method. Experience unnecessary. Write for free samples showing finishes. Gunmetal Co., Ave. "D," Decatur, Ill.

Silvering Mirrors, French plate. Easily learned, immense profits. Plans free. Wear Mirror Works, Dept. 27, Excelsior Springs, Mo.

Will pay cash for sole right to novelty idea or invention that retails for 10 cents. Address Lock Box 66, Station F, New York City.

Start a cleaning, pressing, dyeing shop. Splendid field, big profits. Plans free. International System, Dept. 21, Excelsior Springs, Mo.

Dollars yearly in your Backyard. No mushroom dope. Particulars free. Metz, 313 E. 89th St., New York.

53 Great Money-Making Plans Free. Universal Bureau—K, Boston, Mass.

Join National Institute Inventors, 8 E. 14th St., New York City, strong protective membership society. Will secure, develop, manufacture, market patents. Dues, $10. Booklet free.

Prepare—Sell Your Own Products. Formulas, trade secrets. Different, dependable. Catalog Free. D-Thaxly Co., Washington, D. C.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by any one at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephensen Laboratory, 18 Back Bay, Boston, Mass.

Advertise. Country town newspapers. Lists free. Pennell Company, Covington, Kentucky.

Hemstitching Attachment, fits any machine, big seller, to be put out on Royalty or sell outright. Address Owner, Box 2210, Denver, Colorado.

Becomes a Landscape Architect. Dignified, exclusive, uncrowded profession offering fine money-making opportunities. $5,000 yearly incomes common. Easy to master through our correspondence course. Established 1916. Get information today. American Landscape School, 66 M, Newark, N. Y.

Chemical Expert will furnish formulas and trade secrets. All lines. Lists free. W. L. Cummings, Ph. D., 238 Gordon Ave., Syracuse, N. Y.

Get Into Business for Yourself! Establish and operate "New System Specialty Candy Factory" in your community. We furnish everything. Money-making opportunity unlimited. Either men or women. Booklet free. Ragsdale Co., Drawer 129, East Orange, N. J.

Central Indiana Manufacturers now marketing an entirely new Auto Accessory that makes night driving safe, eliminating glare from approaching headlights, want general sales managers to open branch office, handle exclusive territory and manage salesmen. Some investment necessary. Profit possibilities practically unlimited. Ray Filter Auto Co., Marion, Ind.

Chemistry

Learn Chemistry at Home. Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full-page ad on page 893 of this issue. Chemical Institute of New York, 140 Liberty St., New York City.

Chemical Science. 50c per year. Three copies 25c. Swedesboro, N. J.

Consult a specialist about your problems in chemistry and physics. Reasonable fees. Frank M. Gentry, Consulting Electrochemical Engineer, Box 1699, Boston, Mass.

"How to Make and Use Small Chemical Laboratory," 100 pages, fully illustrated. Construction of laboratory furniture, electric furnace, chemical balance and other apparatus; inorganic chemistry, novel experiments, glass blowing, etc., fully explained. 75c prepaid. Send for new illustrated catalog of Reduced Prices on laboratory supplies and scientific books; free. B. Altman Company, 225 East 110th Street, New York.

Your Chemical or Electrical Problem solved for Five Dollars. Write me. W. Stedman Richards, Consulting Chemist, Box 24020, Boston, Mass.

Electrical Supplies and Appliances

Blueprints. Diagrams of Electrical Connections for nearly every purpose. Authoritative works. Particulars free. Samples 20c. Charles Chittenden, A3024 Matthews, Kansas City, Mo.

Farm Lands, Etc.

Property Owners—Get cash for your real estate, business, invention or other property. To quickly sell, exchange or buy property, any kind, anywhere, write Western Security Co., 102, Hannibal, Mo.

For Inventors

"Inventors' Guide" free on request; gives valuable advice and information for all inventors. Write Frank Lederman, Registered Patent Attorney, 17 Park Row, New York.

Before or after filing your application for patent, it will pay you to read over my "Inventors Advisor No. 4." Free for asking. Write: M. Labiner, Registered Patent Attorney, 3 Park Row, New York.

Get Your Own Patent, $40 complete. Application blanks and full instructions $1. Theodore A. Cutting, Campbell, Cal.

Inventor's Educator, 900 Mechanical Movements. 50 Perpetual Motions. How to procure and sell patents. Mechanical Movements greatly assist inventors, suggest new ideas. Explains how to select an attorney and avoid patent sharks. Price $1.50. Postage free. Fred G. Dieterich, 601 Ouray Bldg., Washington, D. C.

Inventors—sell patent mfgrs. articles similar invention. Guaranteed addresses 5c each, minimum (money order) 50c. General information. Ann Arbor, Michigan.

For Sale

7HB Coventry—Victor two cylinder, air cooled motor, $200.00. Taussig, 1328 Broadway, New York.

For Men

Homespun Tobacco—Chewing, 5 lbs., $1.25; 10 lbs., $2.50; 20 lbs., $41.50. Smoking, 5 lbs., $1.25; 10 lbs., $2.00; 20 lbs., $3.50. Farmers Union, Mayfield, Kentucky.

Are you old at forty? See our advertisement on page 1036 of this issue. The Electro Thermal Co., Steubenville, Ohio.

Formulas

Free—Formula Catalog. Laboratories, Boylston Bldg., Chicago.

Moneymaking Books, Plans, Formulas. Catalog Free. Ideal Book Shop, 5501-E, North Robey, Chicago.

3,500 Money Making Formulas and trade secrets. Over 400 pages, $1.00. Catalogue free. Englewood Book Shop, 7021 B, South Winchester, Chicago.

For the Photographer

Have You a Camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 465 Camera House, Boston 17, Mass.

Games and Entertainment

Tricks, Puzzles, Jokes, Magical Apparatus, Plays, Stage Supplies, Mind-Reading, Acts and Sensational Escapes. Send 10c for 160-page illustrated 1922 professional catalogue. Oaks Magical Co., Dept. 549, Oshkosh, Wis.

Mind-reading Act—Entertain and mystify your friends No apparatus needed; anyone can work it. Complete act for $1.00. Lindner Co., 1890 Park Avenue, New York.

Health

Free to Men—Information of a scientific nature that has brought physical vigor and happiness to thousands. No charge; no obligation. Enclose stamp for reply. Dr. C. I. Wood, 551 East 47th Street, Chicago.

Are you Old at Forty? See our advertisement on page 1036 of this issue. The Electro Thermal Co., Stebenville, Ohio.

Tobacco or Snuff Habit Cured or no pay; $1.00 if cured. Remedy sent on trial. Superba Co., S. A., Baltimore, Md.

Restore Health, Power, Vigor by using the Vaccu-Invigorator. Instrument sent, plain wrapper, $3.00. Standard Importing & Specialty Co., 106, St. Louis, Mo.

Help Wanted

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisemment, page 1010.

Stop Daily Grind. Dependable Plans Free. Easy silvering mirrors, headlights, tableware, etc. Clarence Sprinkle, Dept. 61, Marion, Indiana.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

All men, women, boys, girls, 17 to 60, willing to accept Government Positions $117-$190, traveling or stationary. Write Mr. Ozment, 293, St. Louis, immediately.

Make money in spare time mailing letters. Men, write now, enclosing stamped addressed reply envelope. Normande R Dept., 17 W. 23d St., New York.

Be a Detective; Excellent opportunity; good pay; travel. Write C. T. Ludwig, 1117 Westover Bldg., Kansas City, Mo.

U. S. Government wants Help. Railway Mail Clerks—Clerks at Washington. Men—women over 17. $100-$195 Month. List positions free. Franklin Institute, Dept. M25, Rochester, N. Y.

Firemen, Brakemen, Baggagemen, Sleeping car, train porters (colored). $140-$200. Experience unnecessary 897 Railway Bureau, East St. Louis, Ill.

Be a Mirror Expert. $3 to $10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free prospectus. W. R Derr, Pres., 26 McKinley St., Baldwin, N. Y.

Gov't Railway Mail Clerks start $133 month; expenses paid. Specimen examination questions free Columbus Institute H-1, Columbus, Ohio.

Detectives Earn Big Money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, New York.

Insects Wanted

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 1010.

Educational and Instruction

Learn Chemistry at Home. Dr. T. O'Conor Sloan, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full page ad on page 893 of this issue. Chemical Institute of New York, 140 Liberty St., New York City.

Mathematics Taught by Mail. Arithmetic, Algebra, Geometry, Mensuration, Trigonometry, Logarithms and Mechanics courses. Harding School, 76 Brighton, Highland Park, Michigan.

Used Correspondence Courses only one-quarter original price. Free bargain price list. 1,000 courses. Courses bought. Students Exchange, 45 W. 42d St., New York.

Free. Shorthand course. Secretary, 1552 Broadway Avenue, Grand Rapids, Michigan.

Languages

World-Romic System. Masterkey to all Languages. Primers, 23 Languages, $1.94 each language: Arabic, Bohemian, Bulgarian, Cantonese, Chuniau, Danish, Dutch, English, Scotch English, French, German, Hungarian, Italian, Japanese, Latin, Panjabi, Polish, Portuguese, Rumanian, Russian, Sechuana, Spanish, Swedish. Pronunciation Tables, 94 languages, 30c each language. Languages Publishing Company, 8 West 40th Street, New York.

Machinery and Tools

Concrete Building Block Machines and Molds. Catalogue free. Concrete Machine Co., 305 South Third St., St. Louis, Mo.

Mail Order Business

$50 week evenings—I made it. Mail Order business; booklet for stamp tells how. Sample and plan, 25c. Free, 12 articles worth $3. Al Exp. Scott, Cohoes, N. Y.

Manufacturing

To Order: Metal articles, Models, Tools, Patterns, Experimenting Manufacturing Inventions developed. Cleveland Specialty & Mfg. Co., Scarsdale Ave., Cleveland, Ohio.

Miscellaneous

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 1010.

Motorcycles—Bicycles

Used parts for all motorcycles cheap. State wants. Schuck Cycle Co., 1922 Westlake, Seattle, Wash.

Don't buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 6, Galesburg, Kansas.

Novelties

Crystal Gazing. Book 75c. Also Crystals. Crystal Gazing Co., 122 Station "B," Kansas City, Mo.

Office Devices

Save half on office Machines, Equipment, Addressers, Multigraphs, Duplicators, Dictaphones. Pruitt Company, 172 North Wells, Chicago.

Old Money Wanted

$2 to $500 Each paid for hundreds of old or odd coins. Keep all old money. You may have very valuable coins. Send 10 cents for New Illustrated Coin Value Book, 4x6. We pay Cash. Get posted. Clarke Coin Company, Ave. 15, LeRoy, N. Y.

Patents

"Unpatented Ideas can be sold. I tell you how and help you make the sale. Particulars free. Write W. E. Greene, 106 The Atlantic, Washington, D. C.

Inventions Commercialized. Patented or unpatented Write Adam Fisher Mfg. Co., 205 St. Louis, Mo.

Patents For Sale

Outright or royalty. Carton sanitarily closed and opened at will. Preferred by every woman as container for cereals, sugar, salt, coffee, etc. Box 523, Fairmount, W. Va.

Automatic Time Poultry Feeder. Economically manufactured. Indorsed by authorities. Outright or royalty. Box 523, Fairmont, W. Va.

For Sale or Royalty. Patent No. 1,384,931. Ship-raising device and Safety appliance. It works. Box 523, Fairmont, W. Va.

Brush Pad for Cleaning and Spotting Any Garment, etc., No. 1,224,581, $16,000. C. B. Twyford, 617 Bailey St., Zanesville, Ohio.

Patent Attorneys

Patents! Send sketch or model for search of pertinent U. S. patents and Report, including copies of patents nearest your idea. These earlier patents may offer valuable suggestions for improving or perfecting your invention. No charge for preliminary information or advice. O'Connell & O'Connell, Attorneys, Jenifer Bldg., Washington, D. C.

Inventors: Protect your invention through A. M. Wilson, Inc., Washington, D. C. Over twenty years of efficient, expert, confidential service. Skilled in Radio-Electrical, Chemical and Mechanical fields. Our 1922 illustrated booklet, giving much necessary and very useful information which every inventor should know, will be sent free upon request. Prompt and careful attention. Highest references. Moderate fees. Send sketch or model for our careful opinion and preliminary advice. Write today to A. M. Wilson, Inc. (Radio 3 ABH), 312 Victor Bldg., Washington, D. C. (Successor to business established in 1891 by A. M. Wilson.)

Inventors should write us for our book, "How to Obtain a Patent," which clearly sets forth what may be patented and the necessary steps to protect an invention. It describes the procedure in Patent Office and tells about assignments, licenses and trade-marks, and gives many useful facts about patents which every inventor should know. Many persons well versed in patent matters have pronounced the book the best of its kind they have ever read. It is written so you can understand it. Copy sent free upon request. Talbert & Talbert, Patent Lawyers, 458 Talbert Bldg., Washington, D. C.

Patent application filed on partial payment plan. Trade-marks, copyrights, etc., Milo B. Stevens & Co., 692 F St., Washington, D. C. Estab. 1864.

Free Personal Consultation by New York Patent Attorney. Benjamin Roman, 290 Broadway.

Patents—Write today for Free instruction book and Evidence of Conception blank. Send sketch or model for examination and opinion; strictly confidential. No delay in my offices; my reply special delivery. Reasonable terms. Personal attention. Clarence C. O'Brien, Registered Patent Lawyer, Southern Bldg., Washington, D. C.

Patents Procured. Trade-Marks Registered. A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Building, Washington, D. C., or 2379-T Woolworth Bldg., New York.

Aspirin

Say "Bayer" and Insist!

BAYER

Genuine

Unless you see the name "Bayer" on package or on tablets you are not getting the genuine Bayer product prescribed by physicians over twenty-two years and proved safe by millions for

Colds	Headache
Toothache	Lumbago
Earache	Rheumatism
Neuralgia	Pain, Pain

Accept "Bayer Tablets of Aspirin" only. Each unbroken package contains proper directions. Handy boxes of twelve tablets cost few cents. Druggists also sell bottles of 24 and 100. Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

SEX

Facts other sex books don't dare discuss are plainly told in **"Where Knowledge Means Happiness."** Creates a new kind of married love. One reader says:

It contains more real information than all other sex books put together.

From "Where Knowledge Means Happiness" Copyright 1921

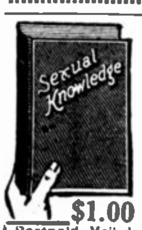
Sent in plain cover, *by return mail*, for $1.00, cash, money order, check or stamps.

COUNSEL SERVICE, Dept. 39, 257 W. 71st St., N. Y.

Are YOU Old at 40?

If so, why? Get quick FREE BOOK about the prostate gland which may cause sciatica, backache, interrupted sleep, depressed and other often serious conditions. It tells of a new drugless home treatment that relieves these conditions. Address

ELECTRO THERMAL CO. 4518 Main St., Steubenville, Ohio



SEXUAL KNOWLEDGE

320 Pages ILLUSTRATED Cloth
By Winfield Scott Hall, M.D., Ph.D.

SEX FACTS MADE PLAIN

What every young man and
Every young woman should know
What every young husband and
Every young wife should know
What every parent should know

$1.00 Postpaid. Mailed in plain wrapper.

Table contents and commendations on request

AMERICAN PUB. CO., 245 Winston Bldg., Philadelphia

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

ADULTS!

SEX KNOWLEDGE BOOKS instructive, authoritative, profusely illustrated in natural colors, etc. Not the cheap sort. Contains everything one should know both before and after marriage to insure health and happiness. LARGE CATALOG FREE.
E. SMETANA AND COMPANY, OWOSSO, MICH.

Patent Attorneys (Continued)

Monroe Miller, Ouray Building, Washington, D. C., patent attorney, mechanical and electrical expert. Best quality of work and results. Moderate charges.

Inventors—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster & Allwine, 242 Ouray Building, Washington, D. C.

Protect your rights. Write for "Record of Invention" and booklet about Patents. Prompt personal service. Advice without charge. J. Reaney Kelly, 612 V Columbian Building, Washington, D. C.

Patents Secured. Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book, telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest References. Write Today. J. L. Jackson & Co., 418 Ouray Bldg., Washington, D. C.

Herbert Jenner, Patent Attorney and Mechanical Expert, 624 F Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

Inventions Patented. Trade-Marks Registered; reasonable charges; prompt service; plain advice; request detailed information. Jaynes & Jaynes, 720 Kellogg, Washington, D. C.

Inventors write me about patents. My fees payable monthly. Booklet free. Frank Fuller, Washington, D. C.

Patents—Prompt, personal efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 18 years actual experience; full information upon request. B. P. Fishburne, 330 McGill Bldg., Washington, D. C.

Inventors. Send sketch or model of invention for opinion concerning patentable nature and exact cost of patent. Book, "How to Obtain a Patent," sent free. Tells what every inventor should know. Established twenty-eight years. Highest references, prompt service, reasonable charges. Chandlee & Chandlee, 441 Seventh, Washington, D. C.

Patents. Send for free booklet. Highest references. Best results. Promptness assured. Send model or drawing for examination and opinion. Watson E. Coleman, patent attorney, 624 F Street, Washington, D. C.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

Personal

Life Revelation with pictorial chart showing your character, talents, suitable occupation, affinity, etc. Send 10c, birth date. St. Germain Society, Dept. 1133, Sharpsburg, Pa.

Hair grown on bald heads. Falling hair stopped. Many proved cases. Indians' secret. Proof box with testimonials, guarantee, mailed 10 cents, silver or stamps. Kotalko Offices, BF-300, Station X, New York.

Lonesome? Make Friends Everywhere. Many wealthy. Fascinating particulars for stamp. Smith, Box 3125 H. Portland, Oregon.

Exchange Cheery Letters with New Friends! Send stamp. Betty Lee, Inc., 4254 Broadway, New York City.

Are You Old at Forty. See our advertisement on page 1036 of this issue. The Electro Thermal Company, Steubenville, Ohio.

Exchange jolly letters with new friends. Lots fun! Send stamp. Eva Moore, Box 908, Jacksonville, Fla.

Phonograph Supplies

Build Your Own Phonograph. Big saving. Pleasant, instructive work. Complete instructions, blue-prints, etc., absolutely free. Write today. Associated Phonograph Co., Dept. AP-12, Cincinnati, Ohio.

Build Your Phonograph. Quality phonoparts. Famous Serenado Motors. Also original Perfection Motors. Electric Motors, tonearms, reproducers, amplifiers, case material, accessories. Free blueprints and building instructions. Big saving. Wonderful results. Prompt delivery. Catalog mailed for ten cents. Hoosier Mfg. & Supply Company, 321 Baldwin Block, Indianapolis, Indiana.

Photoplays, Stories, Etc.

Wanted. Men and women ambitious to make money writing Stories and Photoplays. Send for wonderful Free Book that tells how. Authors' Press, Dept. 131, Auburn, N. Y.

Printing

Everything Printed. Long Run Specialties. Samples. Quality Printery, Marietta, Ohio.

Radio Outfits and Supplies

Agents Wanted in Every City to sell standard radio apparatus on a liberal commission basis. A few stocking agencies open to reliable parties. Delfelco, 12 Meeting Street, Pawtucket, R. I.

Short Stories, Manuscripts Wanted

Earn $25 Weekly Spare Time writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Mo.

Song Writers

Write a Song! Any subject—you can do it. Send words today—I will compose the music. Frank Radner, 6044S Prairie Ave., Dept. 645, Chicago.

Stamping Names

Make $19 a Hundred stamping names on keychecks. Send 25c for sample and particulars. Ex Kaytag Co., Cohoes, N. Y.

Song Poems Wanted

Write the Words for a Song. We compose music. Our Chief of Staff wrote many big song-hits. Submit your song-poem to us at once. New York Melody Corp., 412 Fitzgerald Bldg., New York.

Wanted Song Poems. Good cash prices. Send poem and 35c for necessary instructions and postage. No additional Fee. American Music House, 6242L South Park Ave., Chicago, Ill.

Prosperity and Independence for anyone, producing what public wants in songs. Recognized Songwriter offers services and cautions against spending money on fake propositions. J. Doane, 2128 Alice Place, Chicago.

Stamps and Coins

Stamps Free—Fine Set War Stamps, Surcharged, Unused. Pictorials, British, French Colonies, postage 2c. Midland Stamp Co., Toronto, Canada.

Stamps—20 Unused. All Different. Free. Postage 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

Stamps. 50 varieties—Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5955 Cote Brillante, St. Louis, Mo.

California Gold, quarter size, 27c; half-dollar size, 53c. Columbian nickel and catalogue, 10c. Norman Schulz, Box 146, Colorado Springs, Colo.

Telegraphy

Wanted—Young men and women to learn Morse and Wireless Telegraphy. Railroads and Wireless Companies in great need of operators. We teach you quickly, and procure positions at big salaries. Great opportunities for advancement. All expenses low; can earn part. Write today for free catalog. School established 1874. Dodge's Telegraph Institute, "O" Street, Valparaiso, Ind.

Typewriters

Typewriters sold on payments. Free trial. Payne Company, Rosedale, Kansas.

Ventriloquism

Ventriloquism taught almost anyone at home. Small cost. Send 2c stamp today for particulars and proof. Geo. W. Smith, Room M-742, 125 N. Jefferson Ave., Peoria, Ill.

Wanted to Buy

Cash for Old Gold, Platinum, Silver, Diamonds, Liberty Bonds, War, Thrift, Unused Postage Stamps, False Teeth, Magneto Points, Jobs, any valuables. Mail in today. Cash sent return mail. Goods returned in ten days if you're not satisfied. Ohio Smelting Co., 303 Hippodrome Bldg., Cleveland, Ohio.

Full value paid for old gold, jewelry, watches, diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore, magneto points, war savings stamps, old false teeth. Packages held 4 to 12 days and returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 120 So. State St., Dept. 73, Chicago, Ill.

War Relics and War Photos

For Oens—Relics collected from Europe's battlefields. Completely illustrated catalogue with sample War Photos, 25c. Lieut. Welch, 2117 Regent Place, Brooklyn, New York.

Wireless

Boys, don't overlook this! The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication or our catalogue. Detector with Galena Crystal complete, 50c; the same Detector with Radiocite Crystal, 75c prepaid. Send for yours today. Radio Specialty Company, 100 Park Place, New York City.

Attention! 50 Vacuum Tube Hook-Ups. The greatest collection of Vacuum Tube Circuits ever brought under two covers at such insignificant cost. These diagrams will be found in the great "Rasco" catalogue which contains raw materials and parts in a greater profusion than any other catalogue. 15c in stamps or coin will bring the catalogue to you. Radio Specialty Company, 100 Park Place, New York City.

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparatus are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 35c postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

How to Make Wireless Sending Apparatus. 100 pages—88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound 35c, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Wireless Course in 20 Lessons. By S. Gernsback, A Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Stiff cloth cover, $1.75, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York.

How to Make Radio Frequency Amplifiers. This book is for the more advanced amateur, showing the construction of the Radio Frequency Amplifying Transformer and giving complete constructional data. It shows the application of Radio Frequency to amplifying units that the amateur may already possess and gives 15 hook-ups showing practically every use Radio Frequency Amplifying Transformers can be put to. 32 pages, 15 illustrations; bound in beautiful two-color cover. Prepaid 25c. The E. I. Company, 233 Fulton St., New York City.

EVERY BOY WHO IS INTERESTED

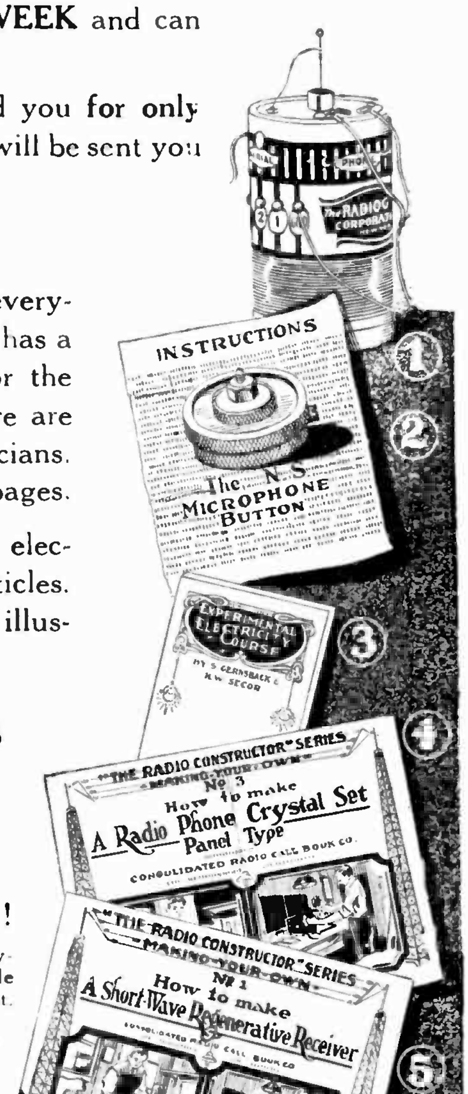
IN RADIO

CAN TAKE ADVANTAGE OF OUR SPECIAL OFFER

EVERY BOY HAS A FEW SPARE HOURS EACH WEEK and can easily obtain a few subscribers to PRACTICAL ELECTRICS.

On this page you will see the special rewards we will send you **for only one subscription.** You can easily earn every one of them. They will be sent you

ABSOLUTELY FREE



PRACTICAL ELECTRICS is the electrical magazine for everyone. It is the only electrical magazine a boy can understand. It has a regular department for beginners, but is just as interesting for the experimenter, the electrician, and the electrical engineer. There are articles each month by students, experimenters and famous electricians. The entire progress of the month in electrics is set forth in its pages.

PRACTICAL ELECTRICS is one of the most interesting electrical magazines published. It contains no long, dry technical articles. Every article is completely illustrated. There are hundreds of illustrations, plans, drawings, charts, etc.

On the opposite page you will find complete description of each reward.

PRACTICAL ELECTRICS is only $2.00 per year

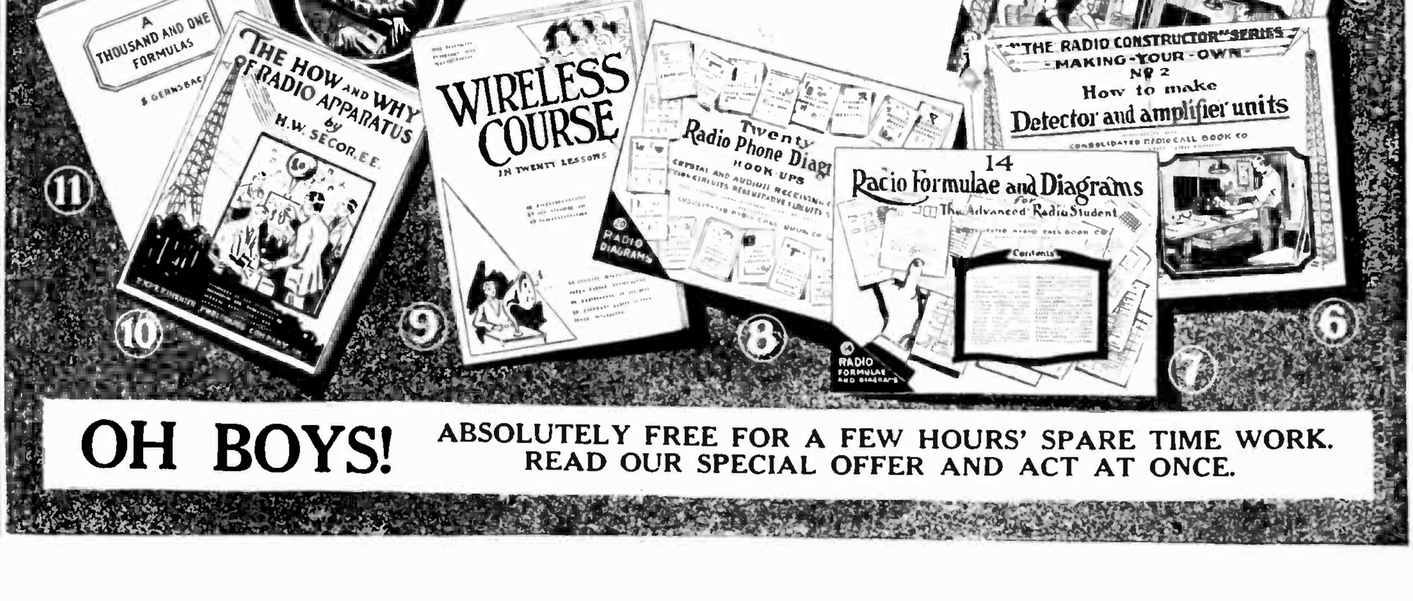
[12 Numbers]

(Canada or foreign 50 cents additional)

EVERY BOY SHOULD HAVE IT!

All articles are written in plain, everyday language. If you need a sample copy to show we will send it free of cost.

SEE OPPOSITE PAGE FOR DESCRIPTIONS



OH BOYS! ABSOLUTELY FREE FOR A FEW HOURS' SPARE TIME WORK. READ OUR SPECIAL OFFER AND ACT AT ONCE.

Descriptive Details of Rewards

We will send you your choice of these rewards.
ONE REWARD FOR EACH SUBSCRIPTION for one year.

REWARD No. 1

RADIOGEM

A complete crystal Radio Receiving Set, will receive up to 25 miles. The outfit consists of all the necessary wire, contact points, detector mineral, catwhisker, tuning coil, instruction book, etc. When you have constructed the Radiogem, all you need is an aerial and a phone.

REWARD No. 2

MICROPHONE BUTTON

The button may be used to amplify Radio Signals by using it in a local circuit. It should be mounted on the diaphragm of a telephone receiver connected to the radio set and in circuit with a battery and a telephone induction coil. You can easily make a highly sensitive detectophone by using a Microphone Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument!

REWARD No. 3

EXPERIMENTAL ELECTRICITY COURSE IN 20 LESSONS

By S. Gernsback and H. W. Secor, E.E.

A Course on the theory and practice of Electricity for Experimenters. One of the most complete and comprehensive treatises of this special subject ever published. Written by the same authors as the famous "Wireless Course." The best electrical text book on the market. Size of books is 6 x 9 in. The book contains 128 pages, and more than 400 illustrations. Limp bound.

REWARD No. 4

Complete Patterns, Diagrams and Instructions How to Make Your Own

RADIOPHONE CRYSTAL SET

PATTERN No. 3

Consisting of a 4 page illustrated Direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 12 inches. All contained in two-color printed envelope, 9 x 12 inches.

REWARD No. 5

Complete Patterns, Diagrams and Instructions How to Make Your Own

SHORT WAVE REGENERATIVE RADIOPHONE SET

PATTERN No. 1

Consisting of a five-page illustrated direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 22 inches, and one blueprint pattern, size 17½ x 22 inches. All contained in a heavy two-color printed envelopes, size 9 x 12 inches.

REWARD No. 6

Complete Patterns, Diagrams and Instructions How to Make Your Own

DETECTOR AND AMPLIFIER RADIO UNITS

PATTERN No. 2

Consisting of a four-page illustrated direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 18 inches, and one blueprint pattern, size 13½ x 15 inches. All contained in heavy, two-color printed envelope, 9 x 12 inches.

REWARD No. 7

14 RADIO FORMULAE AND DIAGRAMS

All formulæ and diagrams are printed on heavy paper in black and blue; and contained in two-color printed envelope 9 x 12 inches.

REWARD No. 8

2 RADIOPHONE DIAGRAMS AND HOOK-UPS

Of Crystal and Audion Receiving Circuits, Amplifier Circuits, Regenerative Circuits, Sending Circuits with Key Chart of Symbols, and Pamphlet "HOW TO READ DIAGRAMS"

All 20 diagrams are printed on heavy paper, each sheet size 8½ x 11½ inches, and together with Key Chart of Symbols and pamphlet, "How to Read Diagrams," are contained in a heavy two-color printed envelope, size 9 x 12 inches.

REWARD No. 9

WIRELESS COURSE IN 20 LESSONS

By S. Gernsback, A. Lescarboura, and H. W. Secor, E.E.

(10th Edition)

A Course that tells you everything you wish to know about "Wireless," starting in lesson No. 1 by explaining the Principles of Electricity. By simple, easy stages, this wonderful Course takes you into "Wireless" by the use of such simple language so skillfully used that of necessity you must understand every word.

Size of book is 7 x 10¼ inches, 160 pages, 350 illustrations, 30 tables, Limp bound.

REWARD No. 10

THE HOW AND WHY OF RADIO APPARATUS

By H. W. Secor, E.E.

This newest book on radio matters fills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time, incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as instruction for teachers and students of the subject in general.

160 pages, 6 x 9 inches. Limp bound.

REWARD No. 11

A THOUSAND AND ONE FORMULAS

By S. Gernsback

A laboratory hand book for the experimenter and for everyone who wishes to "do things." A book brimful with very important and priceless information, collected and selected for years. Invaluable for Students, Engineers, Physicians, Experimenters, etc.

It contains 160 pages. The paper has been especially selected to stand rough handling in laboratories. Size 6 x 9 inches. Limp bound.

REWARD No. 12

(All Three Books)

HOW TO MAKE WIRELESS RECEIVING APPARATUS

The 20 radio constructors who wrote the book know how articles should be made from simple materials.

Book has 100 pages, each 5 x 7 inches, 90 illustrations, many full pages, paper bound in two colors.

DESIGN AND CONSTRUCTION OF AUDION AMPLIFYING TRANSFORMERS

Radio and Audio Frequency Type

This book will be of great interest to all radio amateurs. The transformers have never been described before in print.

Size, 5 x 7 inches. Contains many illustrations, diagrams and working data.

HOW TO MAKE WIRELESS SENDING APPARATUS

Contains information on how to make 30 different pieces of wireless sending apparatus from materials easily obtained.

Book has 100 pages (size 7 x 5 inches), 88 illustrations, paper cover printed in two colors.

PRACTICAL ELECTRICS CO., Inc., 53 Park Place, New York, N. Y.

GENTLEMEN:—Please send **PRACTICAL ELECTRICS** for one year (12 numbers) to each of the following addresses:

Name	Street Address	City and State
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....

Enclosed you will find ...... subscriptions at $2.00 each, making the full sum of $.......... (For each subscription to go to Canada or Foreign addresses 50 cents additional must be added.) Also please send me the Rewards (one for each subscription) numbered as follows:

....

My Name Is .... Street ....

City .... State ....

THE PERIODICAL PRESS, NEW YORK