A LOST WORLD
Refound in the Sahara's Isolation

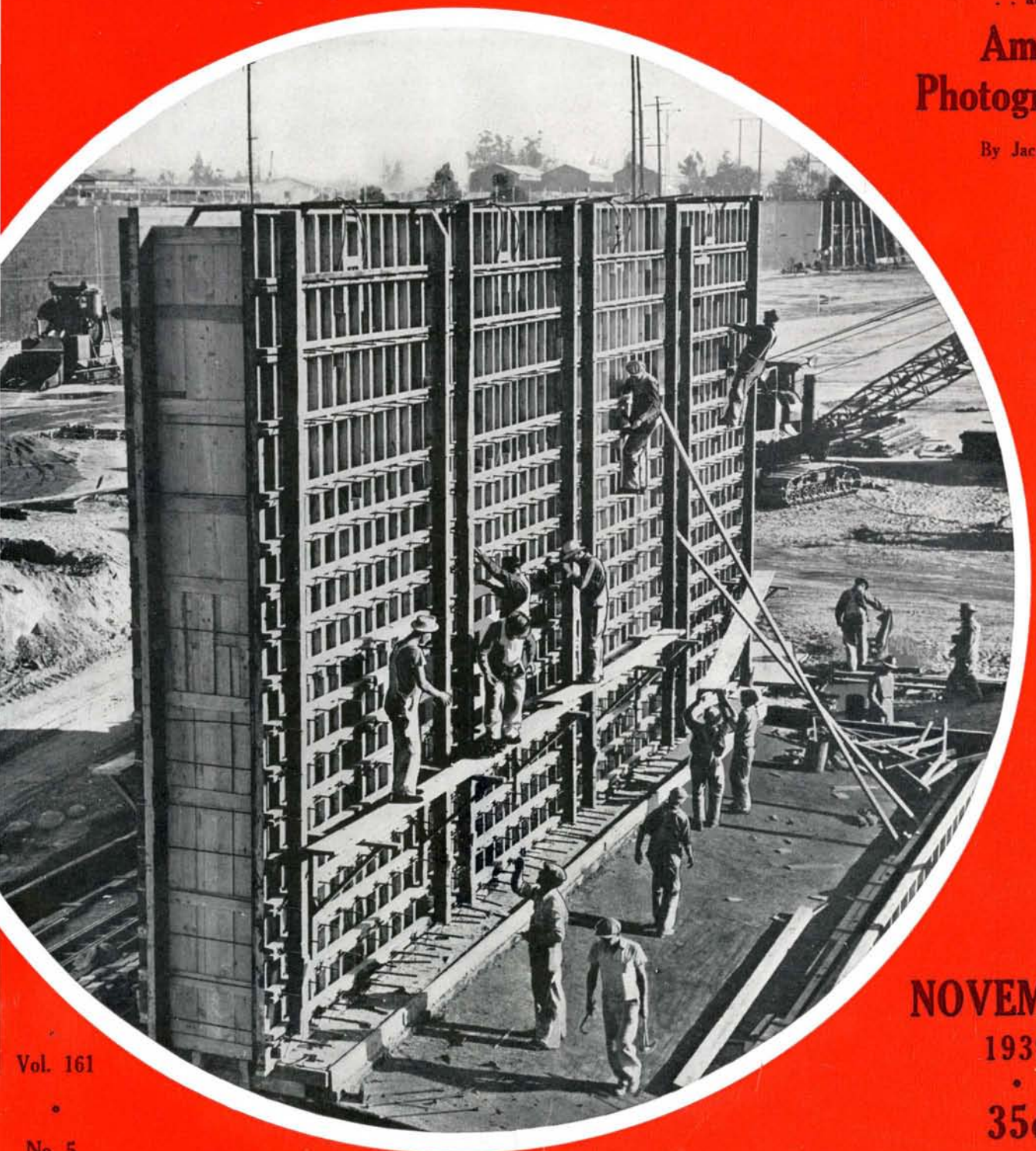
SCIENTIFIC AMERICAN

Including:
A DIGEST OF
SCIENCE & INDUSTRY

. . also . .

Amateur Photography

By Jacob Deschin



Vol. 161

No. 5

NOVEMBER
1939

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For MEN

who want to become independent in the NEXT TEN YEARS

IN the Spring of 1949 two business men will be sitting in a mid-town restaurant. "I wonder what's going to happen next year," one of them will say. "My business is fine now—but the next few years are going to be hard ones, and we may as well face the facts."

The man across the table will laugh.

"That's just what they said back in 1939," he will answer. "Remember? People were looking ahead apprehensively—and see what happened! Since then there has been the greatest growth in our history—more business done, more fortunes made, than ever before. They've certainly been good years for *me*."

He will lean back in his chair with the easy confidence and poise that are the hallmark of real prosperity.

The older man will sit quiet a moment and then in a tone of infinite pathos:

"I wish I had those ten years back," he will say.

• Today the interview quoted above is purely imaginary. But be assured of this—it will come true. Right now, at this very hour, the business men of America are dividing themselves into two groups, represented by the two individuals whose words are quoted. A few years from now there will be ten thousand such luncheons and one of the men will say:

"I've got what I wanted."

And the other will answer:

"I wish I had those years back."

In which class are you putting yourself? The real difference between the two classes is this—one class of men hope vaguely to be independent *sometime;* the other class have convinced themselves that they can do it within the next few years. Do you believe this? Do you care enough about independence to give us a chance to prove it? Will you invest one single evening in reading a booklet that has put 400,000 men on the road to more rapid progress?

This booklet costs you nothing—and for a good reason. It is worth only what you make it worth. It explains how for more than thirty years it has been the privilege of the Alexander Hamilton Institute to help men shorten the path to success; to increase their earning power; to make them masters of the larger opportunities in business.

•

ALEXANDER HAMILTON INSTITUTE

Executive Training for Business Men

To the Alexander Hamilton Institute
169 Astor Place, New York City

Send me without cost a copy of "Forging Ahead in Business."

Name .....

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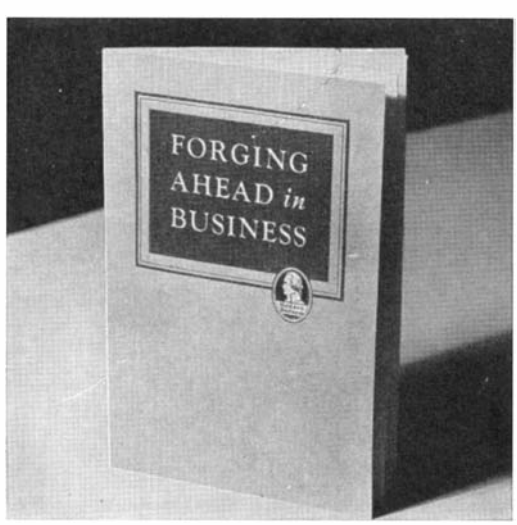
In Canada, address Alexander Hamilton Institute, Ltd., C. P. R. Bldg., Toronto, Can.



"FORGING AHEAD IN BUSINESS" is an interesting, helpful booklet. It is yours for the asking. Send for it. Measure yourself by it. Look clearly, for a few moments, into *your* next few years. Whether or not you will follow the path it points is a matter that you alone must decide.

• • •

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Just a few of the business leaders who have contributed to the Institute training course are such prominent men as:

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Is Your Name Here?

BELOW are the names of some of the most distinguished American families. Our research staff has, over a period of years, completed manuscript histories of each of these families. If your surname is listed, you should have your manuscript. We believe you will find it not only of keen interest, but a source of pride and satisfaction for yourself and your kinsmen.

THESE FAMILY HISTORIES ONLY $2.00 EACH

Each manuscript is a GENEALOGICAL and HISTORICAL study of the family from earliest times. It records the origin and growth of the family in Europe; its place among the gentry there; its part in the early settlement and subsequent history of America, including service in the Revolutionary War; and its achievements and leading representatives in this country. The derivation and meaning of the name are traced; recurrent family traits are brought out; and genealogical data are set forth. A valuable bibliography is included, as well as the authoritative description of a family coat of arms.

Each history is a separate and distinct work painstakingly compiled from the most authentic sources. Reproduced on fine paper and bound in a handsome black cover stamped in silver ink, it is suitably designed for filing among your family records or other documents.

With each order we will send *The Romance of Coats of Arms*, an illustrated, informative publication prepared by the Bureau. If your order arrives promptly we will also include, at no extra cost, our specially designed Ancestry Chart (regularly 35 cents each). It measures 17 by 22 inches and contains spaces in which to record the names of your ancestors in all lines for eight generations.

The following is our latest list, containing 200 new names. The coupon, with $2.00 (no other charge), will bring you your manuscript by return mail. Satisfaction is assured by our unconditional money-back guaranty. Any two manuscripts may be had for $3.75; any three for $5.00. *Send for yours today.* MEDIA RESEARCH BUREAU, Dept. 2411, 1110 F Street, Washington, D.C.

Look Also for Your Mother's and Grandmothers' Maiden Names

Abbot(t)
Abel(l)
Abraham(s)
Abram(s)
Adair
Adam(s)
Adkins
Agnew
Aiken(s)
Akers-Ackers
Albright
Albrecht
Alden
Aldrich
Aldridge
Alexander
Alford
Allen-Allan
Allison
Ambrose
Ames
Amos
Anderson
Andrew(s)
Angel(l)
Anthony
Applegate
Archer
Archibald
Armstrong
Arndt
Arnold
Arthur
Ashby
Ash(e)
Ashley
Ashton
Atkins
Atkinson
Atwood
Austin
Avery
Ayer(s)-Ayres
Babcock
Bach(e)
Bacon
Badger
Bagley
Bailey-Bayley
Bain(e)-Bayne
Baird
Baker
Baldwin
Ball
Ballard
Ballou
Bancroft
Bank(e)s
Ban(n)ister
Barber
Barbour
Barclay
Barkley
Barker
Barlow
Barnard
Barnes
Barnet(t)
Barney
Barr
Barrett
Bar(r)on
Barrow(s)
Barry
Bartholomew
Bartlett
Barton
Bass(e)
Bassett
Ba(t)chelder
Bateman
Bates
Bauer
Baxter
Beach-Beech
Beal(e)-Beall
Bean(e)
Beard
Beardsley
Beatty-Beattie
Beaver(s)
Beck
Becker
Becket(t)
Beckwith
Beebe
Beecher
Beer(s)
Belcher
Belden-Belding
Bel(k)nap
Bell
Benedict
Benjamin
Bennet
Bennett
Benson-Benson
Bentley
Benton
Bergen-Bergin
Bernard
Berry
Best
Betts
Beyer
Bickford
Biddle
Bigelow
Bige(s)
Billings
Bingham
Birch
Bird
Bishop
Bissell
Black
Blackburn(e)
Blackman
Blackwell
Blain(e)
Blair
Blake
Blakel(e)y
Blanchard
Blind
Bliss
Blodgett
Blount-Blunt
Blue-Blew
Boardman
Boggs
Bolton
Bosworth
Bon(gh)ton
Bourn(e)
Bowen
Bower(s)
Bowe(s)
Bowles-Boles
Bowman
Boyce-Boyes
Boyd
Boyer-Bowyer
Boyle(s)
Boynton
Bradbury
Bradford
Bradley
Bradshaw
Brady
Bragg
Branch
Brand
Bran(d)t
Brasie
Brewer
Brewster
Brice-Bryce
Bridges
Briggs
Brigham
Bright
Bristol
Britton
Brock
Bronson
Brooke
Brooks
Broughton
Bro(u)wer
Brown(e)
Brownell
Browning
Bruce
Brush
Bryan(t)-Brian
Buchanan
Buck
Buckley
Buckner
Budd(e)
Buel(l)
Bull
Bullard
Bullock
Bundy-Bunde
Bur(l)burn
Burgess
Burke
Burnett
Burnham
Burns
Burr
Burrell-Burrill
Burrows
Burroughs
Burt
Burton
Bush
Bushnell
Buss(e)-Bussey
Butler
Butterfield
Butt(s)
Buxton
Byer(s)
Byrd
Byrne
Byron
Cady-Cade
Cahill
Cain(e)
Caldwell
Call
Calhoun
Callahan
Callaway
Calvert
Cameron
Campbell
Camp(e)
Canfield
Cant(o)n
Cantrell
Car(e)y
Carle(t)on
Carlisle
Carmichael
Carney
Carpenter
Carr
Carroll
Carson
Carter
Cartwright
Carver
Case
Casey
Cass
Cassell(l)
Cassidy
Castle
Caswell
Chadwick
Chamber(s)lain
Chambers
Champion
Chandler
Chaplin
Chapman
Chappell
Charles
Chase
Cheney-Chaney
Cherry
Chester
Child(s)
Chisholm
Christian
Christie
Christy
Church
Churchill
Clapp
Clark(e)
Clay
Clayton
Cle(a)veland
Clement(s)
Clemens
Clifford
Clifton
Cline
Clinton
Close
Clough
Coat(e)s
Cobb
Cochran(e)
Cody
Coe
Coffey-Coffee
Coffin
Coggan-Coggins
Col(l)burn
Colby
Cole-Coale
Coleman
Coles
Collier
Collins
Colvin
Comer
Compton
Comstock
Conant
Cone-Coan
Conklin(g)
Conley
Conn
Donohue
Connell
Connolly
Connelly
Connor-Connet
Conrad
Conway
Cook(e)
Cooley
Coo(o)mbs
Coon(s)
Cooper
Cope
Copeland
Corbett
Corbin
Cor(e)y
Cornell
Cornwell
Cotton
Cottrell
Couch
Coulter
Courtney
Cox(e)
Craft-Croft
Craig
Cramer
Crane-Crain
Crawford
Crewe(s)
Crocker
Crockett
Crook(s)
Crosby
Cross
Crouch
Crowder
Crowell
Crump
Culbertson
Culler
Culp-Kulp
Culver-Colver
Cummin(g)s
Cunningham
Curry-Currie
Curtis
Cushing
Cushman
Cutler
Dale
Dal(e)y
Dall(e)y
Dalton
Danforth
Daniel(s)
Darby-Derby
Darling
Daugherty
Davenport
Dav(e)y-Davie
David(s)
Davidson
Davi(e)s
Dawson
Day
Dayton
Dean(e)
Decker(t)
De(e)ring
Delan(e)y
Denn(e)y
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Den(n)ison
Denton
Dewey
De Witt
Dexter
Dick(e)
Dickerson
Dickey
Dickinson
Diehl-Deal
Dietrich
Dill-Dell
Dillon
Dinsmore
Dix
Dixon-Dickson
Doan(e)
Dobbs
Dodd(s)
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Dodson-Dotson
Dolan
Donahue
Donohue
Donaldson
Donnelly
Donovan
Dorman
Dorr-Dore
Doty
Do(ug)herty
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Douglas(s)
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Dowd-Doud
Down(e)s
Downing
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Drew
Drummond
Drury-Drewry
Du Bois
Dudley
Duff
Duke(s)
Dunbar
Duncan
Dunham
Dunlap-Dunlop
Dunn(e)
Dunning
Durant-Durand
Durham
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Duval(l)
Dye-Dee
Dyer
Earl(e)
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Eastman
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Eaton
Eddy
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Eggleston
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Elliot(t)
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Ellsworth
Elmore-Elmer
Ely
Emerson
Emery
Engel-Engle
English
Erwin
Estes
Evans
Everett-Everitt
Ewing
Fairbank(s)
Fairchild
Farley-Fairley
Farmer
Farn(h)am
Farrar
Farrell-Ferrel
Faulkner
Fay
Fenton
Ferguson
Ferris-Farris
Field
Finch
Fin(d)ley
Fin(d)lay
Finney
Fish
Fisher
Fisk(e)
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Fitzgerald
Fitzpatrick
Flem(m)ing
Fletcher
Flint
Flood
Flower(s)
Floyd
Flynn-Flinn
Foley
Foote
Forbes
Ford
Forgeman
Forrest
Forsyth(e)
Fort(e)
Foster-Forster
Fowler
Fox
Francis
Frank(e)
Franklin
Fraz(i)er
Fraser
Fred(e)rick
Freeland
Freeman
French
Fritz-Fritts
Frost
Fry(e)
Fuller
Fulton
Furman
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Galbraith
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Gard(i)ner
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Garrison
Gaston
Gates
Gault-Galt
Gay
G(e)ary-Gerry
Gee
Geer-Gear
George
Gerhard(t)
Gibbon(s)
Gibbs
Gibson
Gifford
Gilbert
Gilchrist
Gile(s)-Guile
Gill
Gillett(e)
Gillespie
Gill(l)am
Gilli(e)s
Gill(l)man
Gilmore
Girard-Gerard
Given(s)
Glass
Gleason
Glen(n)
Glover
Glynn
Goddard
Godfrey
Godwin
Goff(e)
Gold
Goldsmith
Good(e)
Goodin(g)
Goodman
Goodrich
Goodwin
Gordon
Gore
Goss(e)
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Gray-Grey
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Green(e)
Greenwood
Greer-Grier
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Gregory
Griffin
Griffith
Grigg(s)
Grimes
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Gross-Gros(s)e
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Grover
Groves
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Gunt(h)er
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Hackett
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Hagen-Hagan
Hager-Haeger
Hahn-Hann
Halg(h)-Hague
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Hamilton
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Ham(m)
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Hammond
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Hanna(h)
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Hardin-Harden
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Hardy-Hardie
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Harlow
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Hart
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Harvey
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Hinkle-Henkel
Hinman
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Hite-Hight
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Huff
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Hutton
Hyatt-Hiatt
Hyde
Hynes
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Ingersoll
Ingra(ha)m
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Isaac(s)
Ives
Jack(s)
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Jacob(s)
Ja(c)ques
Jaeger-Jager
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Jamison
Jarrett
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Jeffrey(s)
Jefferson
Jenkin(s)
Jenks-Jencks
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John(s)
Johnson
Johnston(e)
Jones
Jordan-Jordon
Joy
Joyce
Judd
Judson
Julian-Julien
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Kane-Kain(e)
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Kay(e)
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Kendrick
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Kent
Kenyon
Kern(s)
Kerr
Ketcham
Ketchum
Key(e)s
Key(e)
Keyser
Kidd
Kilpatrick
Kimball
Kincaid
King
Kingsbury
Kinney
Kirby-Kerby
Kirk
Kirkland
Kirkpatrick
Kitchen
Kline
Knapp
Knight
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Knowles
Knowlton
Knox
Kolb
Kramer
Kuhn(s)
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Lac(e)y
Ladd
Lake
Lamb
Lambert
Lancaster
Landis-Landes
Lane
Lang
Lang(don
Langford
Langley
Larkin(s)
Latham
Lathrop
Lat(t)imer
Law
Lawrence
Lawson
Lawton
Le(a)dbetter
Leach-Leech
Leavitt
Lee
Lefe(b)vre
Lehman(n)
Leigh-Lea
Leland
Lem(m)on
Le(o)nard
Leslie-Lesley
Lester
Levitt
Lewis
Lill(e)y-Lillie
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Lindsay
Lindsey
Link(e)y
Linton
Lippincott
Little-Littell
Livingston
L(l)oyd
Lock(e)
Lockhart
Lockwood
Logan
Lombard
Loomis
Lord
Love
Lovell
Lovett
Low(e)
Low(e)ry
Lucas
Luce-Luey
Ludwig
Lund-Lunt
Luther
Lyle(s)-Lisle
Lyman
Lynch
Lyn(e)
Lyon
M(a)cDonald
M(a)cDougal(l)
Mace-Macy
M(a)cFadden
M(a)cFarland
M(a)cFarlane
M(a)cGregor
Mack
M(a)cKay
M(a)cKenzie
M(a)cLean
M(a)cLeod
M(a)cMahon
M(a)cMillan
M(a)cMurray
M(a)cNab(b)
M(a)cNamara
M(a)cPherson
M(a)cRae
Madden
Maddox
Madison
Magee
Maguire
Mahon
Malone(y)
Mann
Manning
Markham
Mark(s)
Marsh
Marshall
Martin
Marvin
Mason
Massey-Massle
Masters
Masterson
Mather
Mat(t)hews
Mat(t)son
Maxwell
May
Mayer
Maynard
Mayo
McAdam(s)
McAllister
McCabe
McCall
McCart(h)y
McClain
McClellan(d)
McClintock
McClure
McCollum
McCallum
McCormick
McCormack
McCoy
McCue
McCullough
McCune
McCurdy
McDaniel(s)
McDonough
McDowell
McElroy
McGee
McG(e)hee
McGill-Magill
McGinnis
McGowan
McGuire
McHugh
McIntosh
McIntyre
McIntire
McKee
McKinley
McKinney
McKenn(e)y
McLaughlin
McLellan
McMillen
McNeil(l)
McNutt
Mead(e)
Mellen-Mellon
Melvin
Mere(d)er
Meredith
Merrill
Merritt
Metcalf(e)
Meyer(s)
Michael
Michel(l)
Middleton
Miles-Myles
Millard
Miller
Milligan
Mills
Miner-Minor
Mitchel(l)
Moffatt)
Monroe
Montague
Montgomery
Moody
Moon(e)
Mooney
Mo(o)re
Mo(o)rehouse
Moran
Morey
Morgan
Morley
Morrill
Morris
Morrison
Morrow
Morse
Morton
Mos(e)ley
Moss(e)
Mott
Moulton
Moyer
Mulligan
Munro(e)
Munson
Murdock
Murphy
Murray
Myer(s)
Nagel-Nagle
Nance
Nash
Naylor
Neal(e)-Nell(l)
Needham
Neel(e)y
Neff
Nelson
Nelson
Nesbit-Nisbet
Neville
Newcomb
Newell
Newman
Newton
Nicholas
Nichol(l)s
Nicholson
Nickerson
Niles
Nixon
Noble
Noel-Nowell
Nolan
Norman
Norris
North
Norton
Norwood
Noyes
Nugent
Nye
Oakley
O'Brien
O'Connor
Odell
Ogden
Oliver
Olmste(a)d
O'Neil(l)
O'Neal
Orr
Osborn(e)
Osgood
Otis
Overton
Owen(s)
Pace
Page-Paige
Palm(e)
Painter
Palmer
Par(r)is
Par(r)ish
Parker
Parkinson
Park(s)
Parke(s)
Parry
Parsons
Partridge
Pate
Patt(e)rson
Pat(t)on
Patten
Patrick
Paul
Payne
Peacock
Peak(e)-Peek
Pearce-Pearse
Pearson
Pease
Peck
Pendleton
Penn
Pennington
Pep(p)er
Perkins
Perrin(e)
Perry
Person(s)
Peters
Peterson
Petersen
Pet(t)it
Petty
Phelps
Phillips
Pickering
Picket(t)
Pierce-Peirce
Pierson
Pike
Piper
Pit(t)man
Pitt(s)
Platt
Plum(m)er
Poe
Polk
Pollard
Pollock
Pomeroy
Pond(e)ground
Pool(e)
Pope
Porter
Post
Potter
Potts
Powell
Power(s)
Pratt
Prescott
Preston
Price
Priest
Prince
Pritt(t)chard
Pritchett
Proctor-Procter
Pryor-Prior
Pugh
Purcell-Pursell
Putnam
Pyle
Quackenbush
Quick
Quigley
Quin(n)
Radcliff(e)
Ramney-Ranney
Ralston
Ramsey
Ramsay
Rand
Randall
Randolph
Rankin
Ransom
Ranson
Rawlin(g)s
Ray-Rae
Raymond
Red(d)ing
Redmon(d)
Redman
Reed-Read
Rees(e)-Reece
Reeve(s)
Reid
Reynolds
Rhodes
Rhoad(e)s
Rice
Rich
Richard
Richards
Richardson
Richmond
Ricker-Riker
Riddle-Riddell
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SCIENTIFIC AMERICAN

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NINETY-FIFTH YEAR • ORSON D. MUNN, Editor

CONTENTS • NOVEMBER • 1939

REBUILDING a river through a congested business and industrial district, as was done with the Los Angeles River (see page 264), necessitates a wide variety of engineering ingenuity. Our cover illustration shows a cantilever type of wall section, to be poured in place. Walls of this type were used in the Los Angeles River project where the right-of-way was narrow and the channel had to make a transition from a trapezoidal section to a vertical section.

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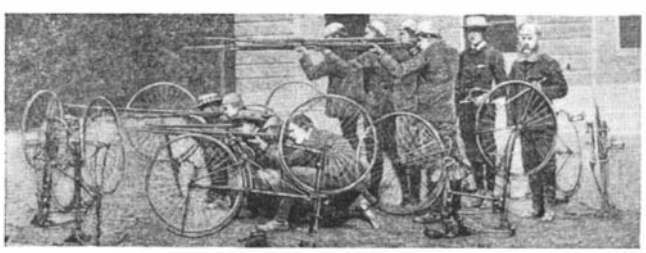
50 Years Ago in . . .

Scientific American

(Condensed From Issues of November, 1889)

CANAL—"The Nicaragua Canal Company, after exhaustive preliminary surveys, borings, etc., and the preparation of complete maps and profiles, has now started in on actual work . . . The total length of the route, as finally located, is 170 miles; of this length, 121 miles is free navigation of Lake Nicaragua and the San Juan River, requiring only a little dredging and improvement; 21 miles is free navigation of basins formed by the flooding of two valleys, leaving 28 miles only of canal excavation. There will be five locks, two on the eastern, three on the western division."

MILITARY BICYCLES—"The art of war is now borrowing from applied science all the resources that are at the latter's disposal, and there is nothing up to velocipedism that is not contributing to the service of the army . . . The illustration shows a phase in the use of the military bicycle as practiced in England, the illustration of



which we borrow from the *Illustrated London News.* A small body of cyclists, ten in number (two sections and a half-section), with officers and bugler, marching in usual order of half-sections—that is, by 'twos'—are attacked by cavalry. At the word of command, 'Halt!' 'Prepare for cavalry!' 'Form square!' each man dismounts; and the respective second half-section move up alongside their first half-section, so as to form a line of four men in front and rear, with a half-section of two men between them . . . The rifles are lifted out of their clips as the machines are . . . placed upside down . . . Lastly, each man, as he lies or kneels down behind his machine, sets his wheels spinning round with a touch of his finger. Such a fence, apart from the *chevaux de frise* of bayonets behind it, forms an obstacle which few horses, if any, would face; and the men inside, in perfect security, can pick off the advancing horsemen with deadly effect."

AUSTRIAN 'PHONE—"Long-distance telephonic communication was opened on October 1 in Austria between Vienna and Prague, a distance of 220 miles. Every subscriber in Vienna can now communicate with Prague, and every word can be perfectly understood and the voice recognized."

EFFICIENCY—"After a steer goes into a slaughter house nowadays, the only thing that is wasted is his dying breath, and if it were possible to find some use for that, no doubt it would be caught and preserved. Nothing else is wasted, from the tip of the tongue to the brush on the end of the tail."

BRIDGE—"The Illinois Central opened its $2,500,000 bridge across the Ohio River at Cairo on the 29th ult. . . . The bridge proper is 2 miles long, and the approaches 4 miles long. The bridge is 58 feet above high water, and 110 feet above low water. The piers are in pneumatic caissons, and are sunk 50 feet below the bed of the river . . . At this depth below the river bed no foundation was reached, and it was impossible to sink the piers further. They were consequently packed with sand, and the immense bridge is really sustained by the friction of the sand on the sides of the piers."

ARMOR PIERCING—"At the Paris exhibition the firm of Holtzer show a shell which pierced a steel plate 10 inches thick and landed entire without a flaw 800 yards, or nearly half a mile, distant from the target. Only the point of the shell was slightly distorted."

AERIAL PHOTOGRAPHY—"A new use has been found for the carrier pigeon in Russia—carrying negatives taken in a balloon to the photographer's dark room."

IRRIGATION—"A large force of men is at work constructing an irrigation canal fourteen miles long, to irrigate a tract of 50,000 acres in Fresno County, California. The canal will be 60 feet wide and 6 feet deep. This tract of land will be cut up into 20 acre farms and placed on the market."

ARGENTINA—"The Argentine Republic is growing at a really remarkable rate, Buenos Ayres, its capital, having a population of nearly half a million. In 1888 it had foreign commerce of $280,690,000, of which $172,410,000 represented imports, including $44,000,000 coin, and $108,280,000 exports. Its demands for supplies for the construction of railroads, which, in 1887, were only $3,500,000, rose in 1888 to $13,600,000. Of agricultural products, it exported in 1887 $21,257,320, against only $8,341,336 the previous year."

WELDING—"The Thomson Electric Welding Company, at their Lynn works, have . . . been able to weld wire cable 15/16 inches in diameter for a cable to be used on a cable railroad, showing greater efficiency than was thought possible in doing this very difficult work. Although the strength of joints obtained by splicing was about thirty percent that of the original cable, yet it was found from tests made at the Watertown arsenal of electric welds made of this cable that eighty-seven percent of the efficiency of the rope itself had been obtained in these welds."

JAPAN—"Let us take a glance in the direction of Japan. Here we are astonished by the wonderful progress she has made since Perry's expedition, and especially during the last twenty years. Her power and prosperity are steadily increasing. The recent adoption by Japan of a constitutional form of government was a great advance in the path of progress, and marks a turning point in her history. Japan is destined to be one of the great states of the future."

PULLMAN—"The . . . Pullman's Palace Car Company . . . is now supplying with sleepers 117,854 miles of the 160,000 miles of railroad in the United States . . . The total number of employes of the company is 11,063, and these employes received in wages nearly $6,000,000 during the past year."

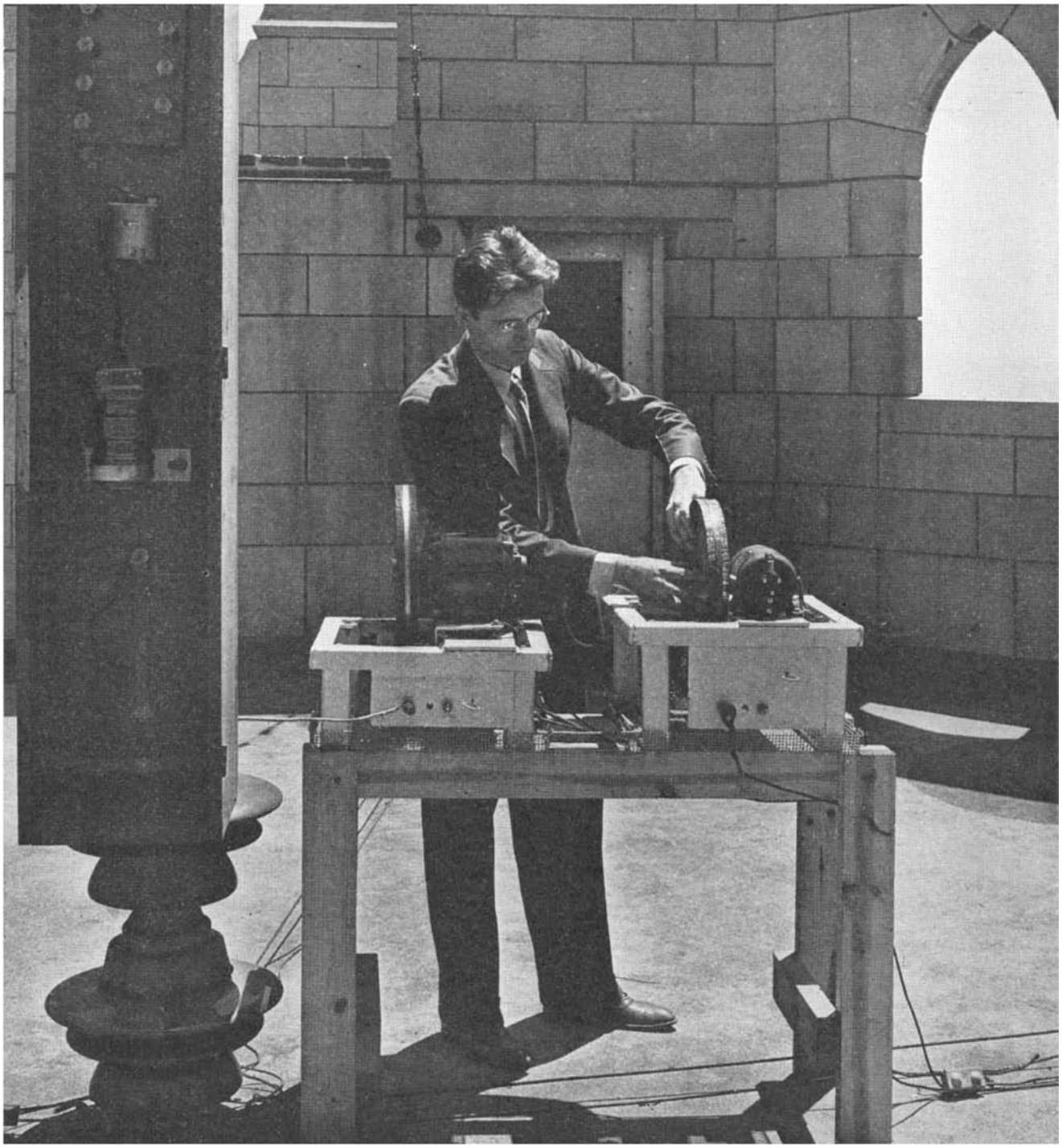
AND NOW FOR THE FUTURE

¶Is Light Slowing Down? Fundamentals of Science Rest on the Answer. By Douglas W. F. Mayer.

¶The Klystron, Ultra-High Frequency Radio Generator, Makes Flying Safer. By Andrew R. Boone.

¶Life's Debt to Death: How Plants Struggle for the Perpetuation of the Species. By Edwin R. Bogusch.

¶Horse-Trader Solomon and the "Pittsburgh" of Palestine Which He Built. By Nelson Glueck.



LIGHTNING IS TRAPPED AND DISSECTED

SCIENTISTS have almost literally snatched bolts of lightning from the skies with the device pictured above. Installed atop the 42-story Cathedral of Learning in Pittsburgh, by Westinghouse engineers. it is called a fulchronograph because it measures both time and amperage of a lightning stroke, broken into tiny bits for analysis. Already it has captured one bolt lasting 1/60 of a second and having a maximum current of 21,000 amperes. Its heart is a slotted wheel—filled with projecting laminated magnet steel fins—which is rotated through two coils which carry the total surge of lightning that passes safely through a new type of arrester. Because of the speed of the wheel and the number of fins, the device can make a recording every 40 millionths of a second. It will give valuable assistance to engineers perfecting power line protection equipment.

All photographs by R. F. Peel

No sinecure is a motor expedition through the Sahara. Though the great desert (Sahara means "desert") is very largely rock and not the traditional sand, enough of it really is sand to provide a motorist's nightmare. Note steel channels under wheels

A Lost World Refound

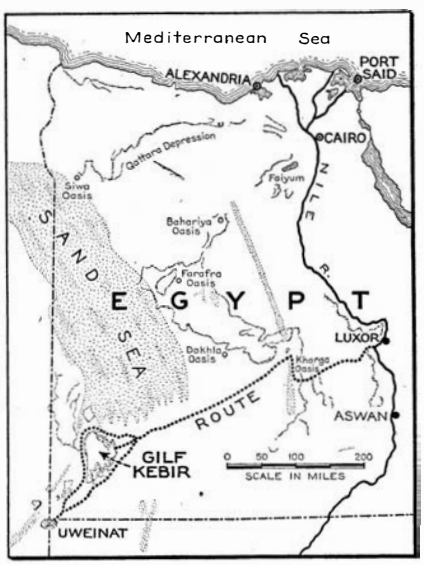
On a High Plateau Far in the Sahara's Isolation, Archeologists Have Discovered Evidence of Early Man's Culture . . . A Land Formerly Wet and Fertile

By MAJOR R. A. BAGNOLD
British Army

FOR several hundred thousand years man of the lower and middle Paleolithic Age roamed over the tree-covered expanses of what is now the Sahara, trapping game and chipping stone implements of fixed, almost unchangeable, design. Then the rainfall dwindled, probably because of the final recession of the ice-cap over northern Europe. The people were forced to accommodate themselves to the changed conditions.

We know nothing of the details of human movements during this enormous period, and very little even of the outline. At some unknown date, many thousands of years ago, the people of the North African plains began to domesticate cattle and to pasture herds in the thinning vegetation. Later on they learned to eat cereals as well as meat, and ground some sort of wild grain. These changes appear to be connected in some way with the development of the Neolithic culture with its bewildering variety of stone implement types.

Then, very recently, between 5000 and 10,000 years B.C., there came a further stage of desiccation. The great plains dried up and were abandoned. Man migrated to the highlands bordering the desert where more rain still fell, and to the banks of the river Nile where they could grow grain without the need of any rain at all. Here began that settled life which, stimulated by contacts with more advanced communities in the east and northeast, very soon gave birth to the great civilization of ancient Egypt.



Redrawn from *The Geographical Journal*

A sketch-map showing the route of the expedition from the Nile 500 miles to the west into deserts so uninhabited that the trip seemed like a visit to a strange planet

Archeologists have concentrated largely on this last settled phase, but no funds have been available for a systematic examination of the old motherlands, chiefly because the Libyan Desert is so vast and waterless that, until recently, prolonged and detailed work far away in the interior was thought impossible.

This great desert, roughly the size and shape of India, is indeed overwhelming in its lifeless silence and its sandy desolation. No vegetation of any sort exists except in the oases, for even a sprinkling of rain now falls on any one place less often than once in ten years. Seeds carried by the wind may germinate after a rare shower, but they quickly die in a ground whence all the fertile humus has long ago been blown away. The oases lie at the bottoms of deep and wide depressions, often surrounded by cliffs. They have been ex-

cavated by the wind down to the level of the underlying artesian water which originates in rainfall far away on lands outside the desert region. The oases nearest to the Nile and to the Mediterranean are large, and support a permanent population, but the majority consist merely of a few date palms, some swamp grass and reeds, all struggling to live in salt-encrusted soil. Some are mere water-holes which become filled with sand and have to be dug out afresh by travelers needing water.

But even the water-holes are from 200 to 400 miles apart. Between them stretch bare rock plateaus, dead-flat sheets of sand a single one of which may be 5000 square miles in area, and ranges of giant sand dunes running straight and continuous for hundreds of miles. One or two ancient and now disused caravan routes cross the corners of the desert from one oasis to the next, but it is unlikely that any Bedouin tribes have roamed over such a landscape since the final drought overtook it thousands of years ago. For, without grazing on the way, no camel can do a journey of more than 350 miles, or 15 days, without water; and half such a journey is an effort.

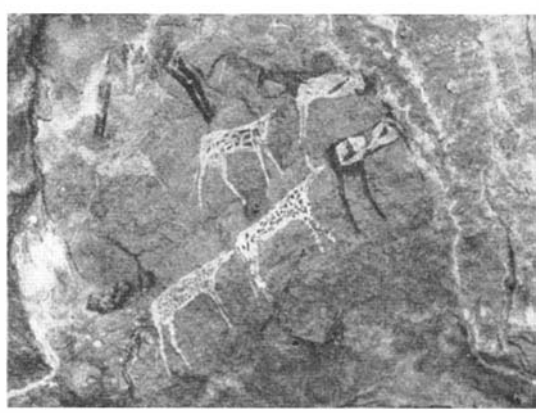
AN expedition by car into the interior resembles a voyage of discovery at sea. With three specially equipped light vehicles a party of six can be self-contained as regards motor fuel for 1400 miles, and can remain for long periods out of reach of water. Though tire marks persist in some places for 25 years and longer, there are no regular beaten tracks; and for fear of losing their way travelers prefer to steer their own route, keeping a dead-reckoning course by day, and checking their position by the stars when camped for the night. Water is sealed in four-gallon cans, and may be kept in depots for many years without ill effects. One quickly becomes accustomed to a daily water ration of only four pints. Kit and equipment are cut to the bare minimum to save weight for essential supplies. No tents are carried; one sleeps well on the open sand, without fear of attack by man or beast, by insect or microbe. The air is keen and envigorating in winter. Yet great caution and forethought are necessary. A party stranded beyond walking distance of an occupied oasis can have no hope of survival.

Within the last 15 years many such expeditions, led at first by the great Egyptian explorer Prince Kemal el Din, and later by the writer and others, have penetrated westward from the Nile beyond the frontiers of Egypt, even as far as the Thibesti Mountains 900 miles across the desert. The object, being largely geographical, great distances—4000 to 7000 miles—were covered rapidly on each occasion. As a result, the curtain of mystery and legend that had hung over the country since ancient times has been lifted. All the major geographical features, including the existing oases and the low-lying areas where water might be found near the surface, have now been mapped, albeit rather hastily. Some idea, too, of the immense wealth of archeological material had been gained.

In 1938 a new experiment was tried out successfully. A party of nine men, including the Egyptologist O. H. Myers and three native diggers, was enabled, through the generosity of the late Sir Robert Mond, to spend two months in a detailed examination of one promising area lying 160 miles from the nearest well.

In the very center of the desert, and at the extreme south-west corner of Egypt, lies the solitary mountain of Uweinat. Northeast of it, just visible on the horizon, the level of the yellow, featureless plain rises abruptly by a continuous 1000-foot wall of cliffs, for all the world like some black forbidding coastline, to the isolated plateau of the Gilf Kebir.

The general outline of the plateau had already been mapped roughly from below, and its cliffs had been traced 150 miles northward till they disappeared under the mighty billows of the Sand Sea dunes; but neither the deep winding creeks and fiords which were seen to penetrate the outer wall, nor the upper surface beyond the flat monotonous skyline of the cliffs, had ever been explored. Though now completely waterless, it seemed most probable that the extra rainfall induced by these highlands would have continued to support a remnant of the old population long after the plains below were dead. If so, much interesting archeological material was likely to be found. Our hopes were justified to an almost embarrassing extent.



Cave paintings in red, white, yellow. Age unknown—probably between 4000 and 6000 years, yet unused pigments lay on the ground below, just as the artist had once left them

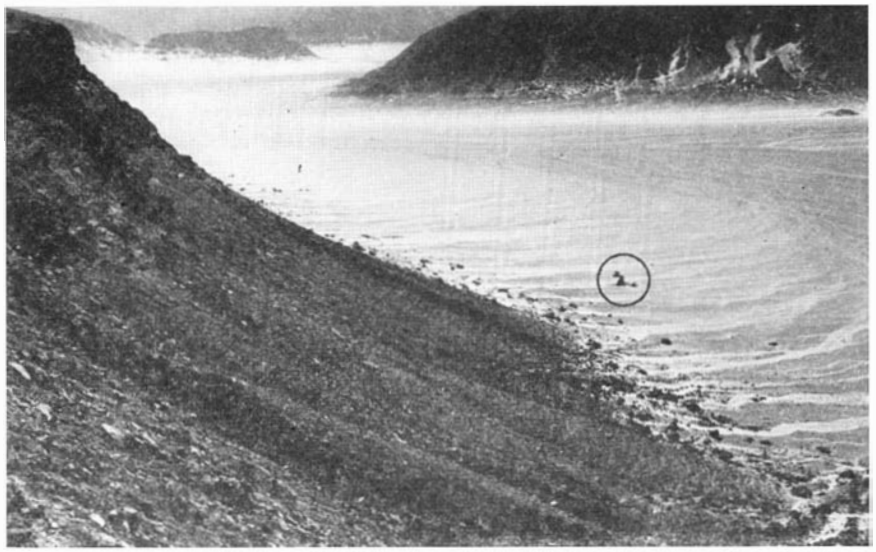
Below: **Top of the Gilf plateau, showing some of the cliffs, 1000 feet in height, which surround this odd, remote world set atop of another odd remote world in the desert's fastness**

The expedition was indeed a journey into the past. For in this country time stands still. Nothing changes; nothing has been disturbed. The Neolithic grinder yet lies in the hollow of the stone quern, just as some Stone-Age woman left it ages ago. The very hearths are there, strewn about with beads, trinkets, and household tools. The ashes look no older than those of a modern Bedouin encampment. On the walls of caves under the great cliffs there still survive the vivid paintings of the ancient people themselves. One sees folk clad in strange primitive garments engaged in lively dances, and tending cattle that would now find no single blade of grass. In the same caves, and on the rocks

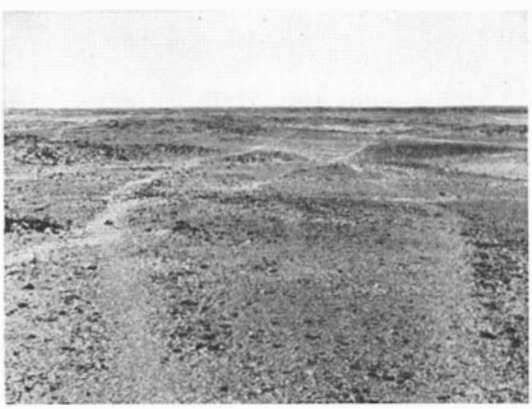
nearby are older paintings and cruder incised drawings of far earlier peoples shown hunting beasts that have long since disappeared.

This timelessness constitutes a difficulty, for one never knows into what age one has by chance arrived. Our first camp beneath the cliffs, sited among remains of a Neolithic folk whose date was guessed as about 5000 B.C., was found to border also on the dim past of 200,000 years ago; for it lay on the edge of a much larger settlement of Acheulean man whose distinctive and well-known Paleolithic implements covered an area of more than a square mile of country and mingled with those of the later age.

For the first three weeks, while the archeologists were at work on these sites, two of us with a single car threaded our way along the bottoms of each, in turn,



A dry valley penetrating into the Gilf plateau. A car, seen as a dot behind two rocks jutting out of the sand within the circle, gives the scale of grandeur



Left: On top of the Gilf plateau today are tracks made thousands of years ago. In all this time there has been nothing to change them: an almost wholly static world

of the long gorges that pierce the Gilf plateau, mapping as we went. Always the same towering cliffs hemmed us in. Counting all the branches and ramifications of the valleys, the total cliff frontage must exceed 2000 miles, yet nowhere apparently could a route be found by which a car could be driven to the top; and we despaired of ever being able to survey the "Lost World" above. At last, however, a very tall sand drift was discovered whose upper slope spanned the final hundred feet of overhanging rock. After four abortive attempts to charge up it with our car unloaded, the skyline suddenly fell away: we were upon a rock surface even flatter than the plains below.

To our astonishment a row of cairns already marked the spot, and well-beaten tracks led away into the mirage over the unknown table land. We had unwittingly hit upon a pass probably last used by the Stone Age people when the lifeless yellow plain below was green.

DURING the days spent on its top the Gilf forced upon us the complete illusion of living upon a cliff-girt island rising from mid-ocean: the endless succession of headlands, all of even height, the cliffs beneath them falling shear from the flatness of the landscape without preliminary drainage slopes, the limitless plains 1000 feet below, so far down that their blurred yellow features fade away into the shimmering haze. Even more striking was the steady booming of the wind that sweeps continually over the plateau and swirls away into space over the edge of the cliffs: nothing could better imitate the roar of breakers on a distant beach.

There grew also an uncanny fancy that the ancient people were still about —that there was nothing between them and us. The place has the utter remoteness of another world. One felt suspended high above the desert below, itself many hundreds of miles from the nearest habitation. The surface is a harsh barrenness of broken rock. Yet a network of paths cross and re-cross it. Lines of stones are laid out in curious patterns, as if by children playing at forts. Implements and stone flakes are everywhere; near the cliff edges the ground is literally covered with them, some blackened by the sun, but others so fresh they might be yesterday's chippings. We expected at any moment to witness the return of their makers, uncouth figures clambering up the skyline of the cliffs, hammer-stone in hand, to resume their eternal rock-breaking.

Life during those two months was by no means uneventful in other respects. Violent sandstorms broke upon our little camp, which was once nearly buried, in our absence, by the shifting of a nearby dune. On three occasions we heard the famous "song of the sands," each time in the stillness of the night. Without warning the whole ground reverberated for many minutes with a loud and low-pitched hooting that issued from the surrounding dunes. Operating 200 miles away from the rest of the party two of us became stranded owing to a serious accident to our one car, and had to walk 25 miles to a pre-arranged rendezvous with the others, carrying all our supplies of water and food on our backs. But, to the writer at least, the most lasting memory of the expedition doubtless will be a trivial incident which happened in a cave in which we had taken shelter for the night from the cold wind. The beam of a torch fell on an artificial rock ledge. On the ledge lay a solitary stone knife left behind by the last occupant untold centuries ago, just as we ourselves would empty our pockets before going to bed.

[The "booming of the wind," described by the author, is due to myriads of aeolian whispers—slight sounds in the vortexes in the lee of minor obstructions —but the "song of the sands," also mentioned, is not clearly understood by scientists.—*Ed.*]

This expedition has proved the possibility of archeological work under the worst desert conditions. Years of patient work will be required before the complex story of man's wanderings in North Africa can be disentangled. It is to be hoped, however, that the evidence so marvelously preserved can be collected while it is still intact, before the adventurous sight-seer has unthinkingly rifled the sites of their most important implements, and before the artist, intent on copying the precious wall paintings in the caves, has trampled on the contemporary floor relics which alone can correlate the paintings with the implement sites outside.

River Rebuilt to Curb Floods

Engineers are Protecting Los Angeles and Surrounding Area . . . Flood Control and Water Conservation Dual Aim

By ANDREW R. BOONE

Los Angeles River during the flood of March 1938. Abrupt curves, where river breached and caused damage, have been straightened

UNDER conditions existing until recently, according to Major Theodore Wyman, Jr., U. S. Engineer Department district engineer, a great flood would practically cut off access to the city of Los Angeles, with its population of 1,500,000. In fact, Major Wyman pointed out that the wide plain on which Los Angeles is situated is under a more dangerous flood menace than any similar region in the United States.

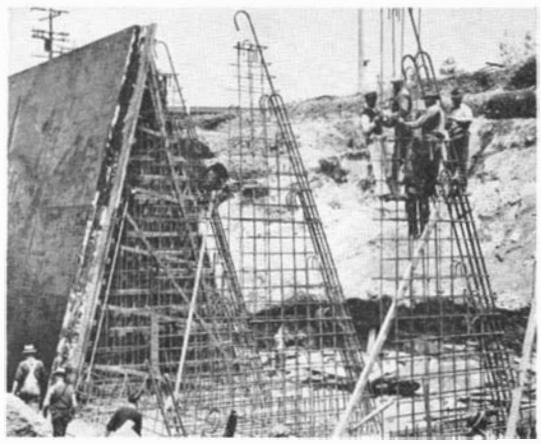
Accordingly, Army engineers and the Los Angeles County Flood Control District are literally rebuilding the Los Angeles River, a stream which, in 40 miles, experiences a fall equal to that of the Mississippi River between Omaha, Nebraska, and the Gulf of Mexico. Rebuilding the river is part of a broader flood control plan. Already Los Angeles County has spent $60,000,000 in building parts of the protective works. Present plans call for an expenditure of $70,000,000 more. But amounts of money to be spent give no idea of the engineering difficulties and problems involved; not only must flood waters and debris of the discharging flood be curbed, but also as much water as possible must be conserved to replenish ground water storage. The life of much of southern California depends upon such stored waters.

Work to date, recommended by the Board of Engineers for Rivers and Harbors and approved by the Chief of Engineers, has been done at points where floor danger was most imminent. In foothill areas, some 600 basins and dams have been constructed to trap water-borne debris and to check water traveling at high velocities; channels have been constructed to control the water flowing from these basins. Below the foothills and on the coastal plain, various channels have been enlarged, straightened, and provided with bank protection, or enclosed within reinforced concrete channels.

The major drainage system of this area is formed by two main channels—the Los Angeles and San Gabriel Rivers. These are interconnected by the Rio Hondo, through which water from the upper San Gabriel flows into the Los Angeles River. In general, these rivers have their headwaters in the San Gabriel Mountains, a portion of the Sierra Madre range.

Most important of the streams, insofar as their rampages may affect concentrated population, is the Los Angeles River. This stream, 70 miles in length, may be bone dry in summer, and then carry water at the rate of 90,000 cubic feet a second through downtown Los Angeles during a winter flood. Hence, to save congested areas within the city proper, as well as outlying areas, the improvements proposed for the river include construction of a leveed channel from its headwaters to the ocean; construction of three flood-control basins; and channel improvement in two washes which empty into the river, as well as on other tributaries.

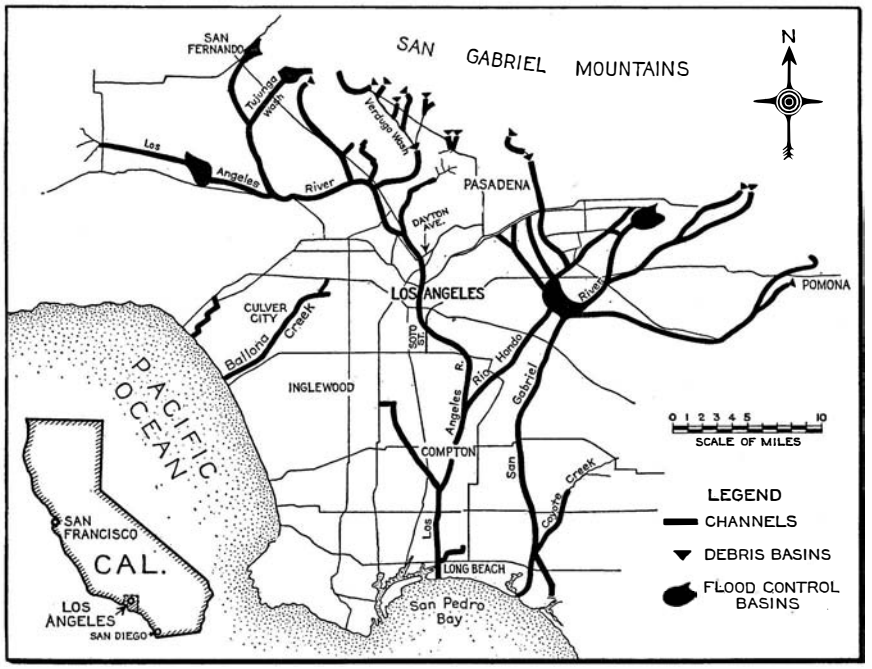
Most dramatic, perhaps, are the straightening, widening, and deepening of the river within the congested district



Left: Placing steel for buttresses used where vertical channel walls merge gradually into sloping walls

Below: Construction in a congested area, with mountain on one side and railroad yards on the other. The channel bottom is being paved here

of Los Angeles. Were you to follow the river from its headwaters (see map) you would first come upon an excavated trapezoidal earth channel for a distance of some eight miles; a gunite trapezoidal channel for 5.3 miles above the junction with Tujunga Wash; a concrete and rock paved channel from this wash 7.6 miles to the junction with Verdugo Wash; and a trapezoidal channel with concrete slab or grouted rock bank protection from about this point 6.8 miles to Dayton Avenue, with a special concrete section at the inlet of Verdugo Wash. From Dayton Avenue, the channel traverses the congested business and industrial districts for a distance of five miles. Due to limited rights-of-way available and the proximity of main-line railroads on each side, channel dimensions vary throughout the reach. At some points the channel must be deepened, with consequent faster stream flow. From Soto Street to the sea, several methods of construction apply.



Local map showing whole flood control project, of which Los Angeles River reconstruction is part. Inset map gives location of the area

wide with side walls 31 feet high, has been provided. Here, velocity is figured for 83,700 cubic feet a second at about 14 miles an hour.

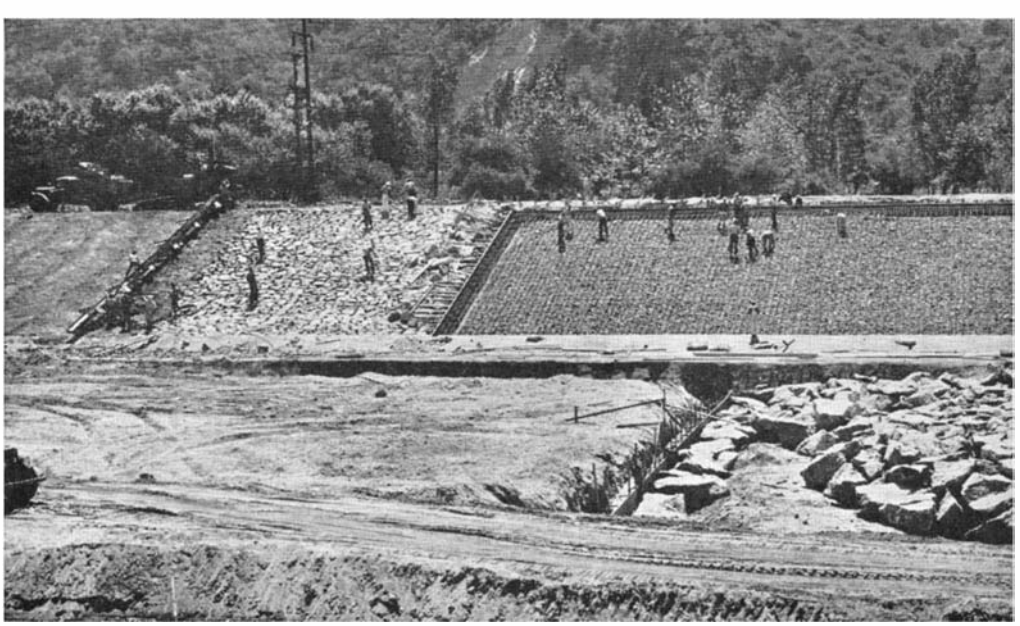
From many points of view, re-building this fractious stream presents engineering novelty. It is only part of a larger program, however: that of saving both life and property over a wide area of southern California and conserving water that agriculture and industry may not suffer. How well the engineers have built only time and flood can tell.

Left: **Settling basin at junction of Verdugo Wash and Los Angeles River, showing baffles (foreground)**

Below: **Baffle walls built across the channel (in right foreground) are to guard against over-scouring**

Graceful transitions are made from inclined to vertical walls. In some sections rip-rap may be hand-placed and grouted, concrete being poured down a spout from a paving machine or delivered via boom and bucket. Elsewhere, reinforced concrete slabs may be placed over derrick stone. Again, a transition section of reinforced concrete slab buttresses merges a trapezoidal section with a vertical wall section, the latter perhaps of cantilever type which is poured in place.

During flood, it is anticipated that velocities through the downtown area will vary from 10 to 24 miles an hour, speed depending upon the section. For example, for a distance of 1900 feet, a rectangular concrete channel, 177 feet



Termites Of The Sea

Worm-Like Mollusk . . . Honeycombs Piling, Timbers . . . Biologist Studies It In Barn Laboratory . . . Records Its Depredations . . . Advises on Protection

By J. D. RATCLIFF

A TRESTLE crashed, dumping a train into San Francisco Bay. Nearby, a ferry slip mysteriously collapsed. At Provincetown, Massachusetts, a fish pier fell into the Atlantic. A bridge keeper's house, supported on piling driven into a river that feeds Boston Harbor, tumbled into the water. All of these mishaps, and thousands of others like them all over the world, were caused by the tireless burrowings of the Teredo, a marine creature so fragile that it all but defies human handling, yet sturdy and persistent enough to honeycomb the toughest woods—teak, mahogany, eucalyptus.

Few of man's tiny enemies wreak such destruction. In three years, the Teredo did $5,000,000 worth of damage to Boston Harbor; in a four-year invasion of San Francisco Bay, $25,000,000. It now seems ready to attack the richest, biggest harbor of all—New York.

This swift, secret destroyer has been with us for centuries. The ancient Greeks and Romans called it the shipworm, and sheathed their fighting vessels with copper against its ravages. Only recently have we discovered exactly what it is, how it lives, and how its depredations in our harbors can be prevented. The world's battle against it centers in one cheerful, unorthodox man, William F. Clapp, and in the scientific campaign waged by his selfless, happy-go-lucky laboratory in an old barn in Duxbury, Massachusetts.

The true research worker is often marked almost in infancy. By the time he was 12, young Clapp had an excellent collection of insects, snakes, and shells. In his freshman year at Harvard, he had no difficulty getting a job as assistant curator of mollusca. Taking only those courses which interested him made getting a degree difficult—he has none to this day—but quickly won him a permanent appointment to the faculty. He taught at both Harvard and Massachusetts Institute of Technology, and laid the groundwork for the new science of biological engineering.

FOR 15 years he was chiefly engaged in classifying specimens, making those minute examinations which determine whether a given snail or shellfish belongs to a new species or is only a variety of a species already recognized. He might have remained permanently absorbed in this specialized corner of pure science but for a queer piece of wood that was sent to him in 1920.

This specimen of timber came from a dock in San Francisco, all but eaten away by some marine "termite." What had destroyed it? Those who had sent it wanted to know. After careful study, Clapp named the shipworm of history, *Teredo Navalis,* as the culprit.

Impressed by his diagnosis and his report, a Committee of the National Research Council, formed to investigate the damage done by marine borers along the United States coastline, invited Clapp to join them as a biologist. Confronted by an intriguing practical problem, Clapp embarked on a piece of research which has taken him far beyond his early years of classification and nomenclature in universities and made him a uniquely useful specialist to whom great industrial companies come crying "Biologist, biologist, save my dock."

A pile from Chelsea, Massachusetts, showing the result of a heavy marine-borer attack, especially at mud line

Some people think of research as a peaceful, well-rewarded profession conducted by untroubled men in long white coats working in laboratories supported by great foundations. Nothing could less resemble the conditions under which William F. Clapp has waged his war on the Teredo. His laboratories have been as makeshift and fugitive as a Kentucky moonshiner's still. One laboratory was a total loss because the harbor over which it was built suddenly was polluted by the seepage from oil tankers. Then he set up shop in a 60-year-old schooner, donated by friends, which he fitted up as a marine laboratory, and which the Coast Guard obligingly towed from place to place. When the decrepit schooner sank, he had to begin again. Now the general staff, and the intelligence service with its priceless records of the doings of the enemy, Teredo, in all parts of the world, are housed in an old barn. There, in an atmosphere of casual simplicity and hard work, Clapp and his staff of seven young technicians —at $25 a week—are learning all there is to know about the immense destructiveness of minute animals.

LIFE in the old barn is insecure, hand to mouth, enthusiastically single-minded. Marine borers are discussed with the same vehemence that other people discuss the New Deal—and sometimes that vehemence is all that keeps them warm. One winter the laboratory was so cold that a railroad official found the workers wearing their overcoats. As the railroad company had benefited from their research, it shortly sent a check for $1000—enough for a new heating system. Equipment is often lacking, but if needed badly enough it somehow appears, and a compound microscope, or a filing cabinet, or a pressure heater for experimenting with wood preservatives, miraculously falls from heaven.

Invaluable specimens and records are stored in this pitifully inflammable barn. Here is a collection of marine borers larger than those of all the museums of the world put together. Here are individual records of a million individual wooden piles, detailed data on the fluctuating activity of borers in hundreds of harbors. Everything known about the Teredo—as well as fungi, rats, termites, rusts, and other destroyers of structural material—is recorded here. And a great deal has become known since William F. Clapp entered this almost unexplored

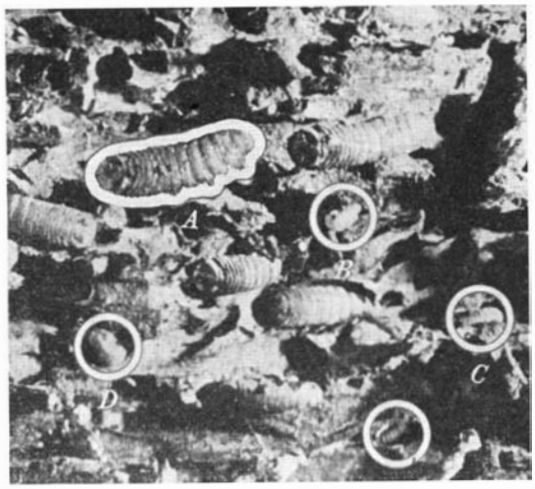
field just a bit more than 20 years ago.

The Teredo, which looks like a greyish-white worm, is actually a mollusk—a relative of the oyster and the clam. This tribe, together with the crustacea (the family of lobsters, crabs, and shrimp) boasts thousands of species whose differences would interest only the biologist, but whose one common point is of painful concern to owners of property on salt water: they chew their way into wooden piling, leaving no visible entrance on the outside, and tunnel until, very often, it unexpectedly collapses.

A pile which seems quite solid may contain tens of thousands of borers, some as much as six feet long. Bored beams and piles which look virginally sound may be broken over one's knee. The Teredo can ruin a costly wharf in as little as two months. It also destroys the planking of boats, and has been known to eat through hawsers, cutting yachts adrift.

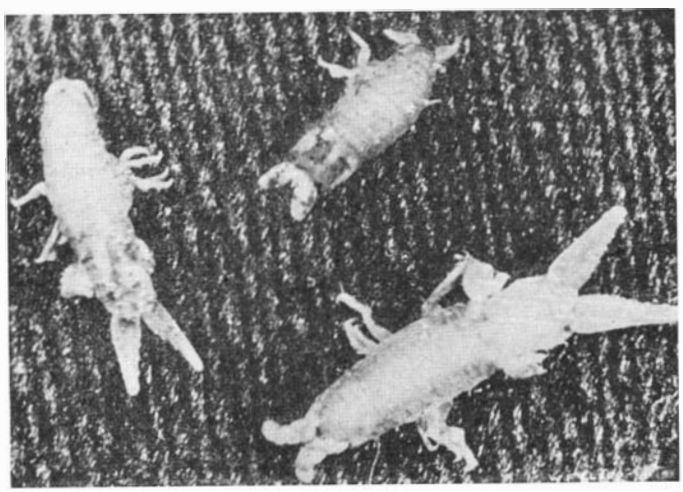
Teredos are launched into the world as free-swimming larvæ; minute in size but immensely promising. Sea currents will deposit some of them on rocks, some on the mud bottom, and some on wooden piling. Wherever they land, they instantly answer some urge of instinct and start burrowing.

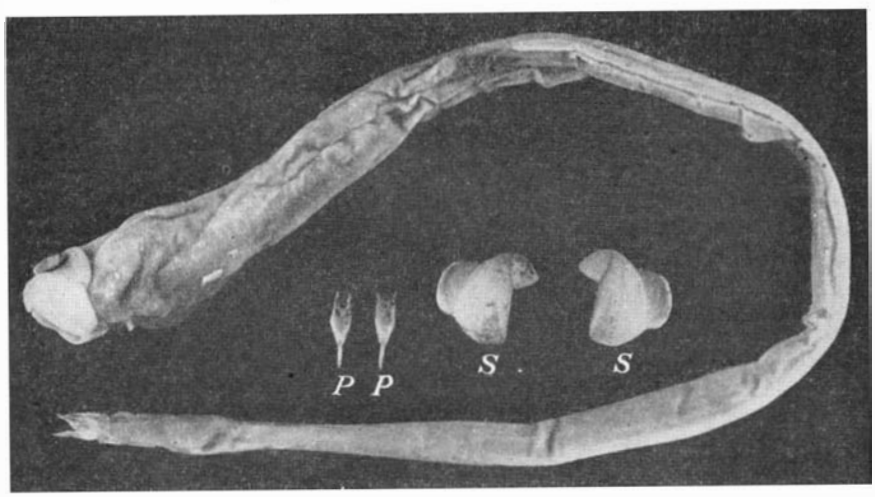
Right: Stages in the life of Limnoria, a marine borer. *A* shows a grown female; *B*, very young specimen (note dark eye); *C*, Young; *D*, Immature



Directly below: Still another marine borer, *Chelura terebrans*, photographed enlarged

Bottom: Teredo Navalis, which sometimes attains a length of six feet. *P,P* are the pallets through which food enters and waste is thrown out. *S,S* are its grinding shells





Those that land on mud and rock quickly perish. Those that alight on timber are more fortunate. After two hours of furious work their minute heads, shaped like clam shells, have rasped away a shelter deep enough to enclose the entire body.

As it progresses from the embryonic to the adult stage, the Teredo becomes a rather complex and impressive creature. It sheds the fragile shell with which it does its boring and grows another which is more sturdy.

The Teredo maintains contact with the outside world, which is to say the sea, by two hair-like branches of a forked tail. Through one it sucks in sea water—and food in the form of minute sea life—and through the other exhausts its body wastes. The opening through which these two siphons extend is no larger than a pinhead, but this portal—a superbly constructed valve—will serve Teredo even though its body attains a length of six feet.

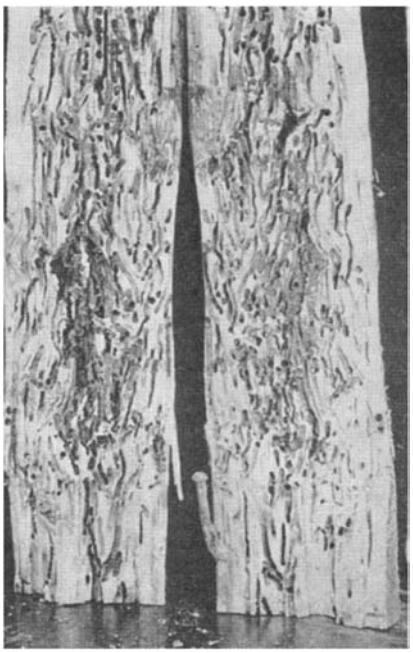
Teredo is a master architect, and a superb housekeeper. It removes all debris by the only means at its disposal: by eating it. It lines its tunnel neatly with lime. In some cases this tunnel is so thick and hard that it cannot be broken by the strongest fingers.

One burrow may approach those belonging to other creatures of its kind, but they never merge. Perhaps only a lime-coated membrane of wood will separate tunnels but each will maintain its discreet identity. The Teredo may bore directly through a timber but it will never bore through to the open on the side opposite its entrance.

When the constant rocking motion of its head has worn out one set of denticles—or teeth—Teredo sprouts another. As many as a hundred rows of these microscopic teeth have been found in one of these creatures. Delicate as they are, no structural wood has yet been found dense enough to resist their boring action. Some varieties of Teredo can even cut their way through poorly mixed concrete.

WHETHER the sawdust Teredo consumes is utilized as food is a matter of dispute. Most authorities think that it is, but Clapp does not agree. He maintains that Teredo's boring is simply an adventure in home building, and that he subsists on plankton, the microscopic drifting life of the seas. Temperature of water determines the span of each year's Teredo activity: in Boston it is two months; in the tropics the Teredo works the year round. An untreated timber which would last 30 years in Labrador may last only one year in Panama.

Why will these borers suddenly invade a harbor which has been unmolested for decades? The answer usually lies in changed conditions. A three-year drought explained the infestation at San Francisco. With very little fresh water going into the Bay, salinity rose and the borers went to work to do staggering damage. Particular attention is now being centered by Clapp on New York



Honeycombing of a pile by marine borers in only two years, despite the cold waters of Newfoundland

Harbor. In the past, pollution of this port has been so great that borers could not survive. When the present clean-up program is completed, they will almost surely arrive in large numbers and go to work. Such a thing happened elsewhere, notably at Lynn, Massachusetts.

Keeping track of borer activity in a hundred harbors scattered throughout the western hemisphere is the monumental task the Clapp Laboratory has set for itself. Are borers on the increase in Puerto Rico? And what varieties are at work in New Brunswick? Are they harmless ones which work in water too deep to damage piling, or the destructive Limnoria? To answer such questions Clapp's endlessly active mind has devised many ingenious aids. One of them is a test block which gives a continuous record of borer activity; another is a trap which captures specimens for identification.

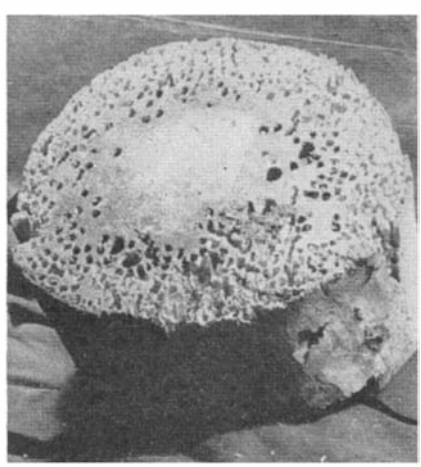
THE test block is engaging in its simplicity. It consists of nine small blocks of pine—ideal Teredo fodder—bolted to a strap of iron. Each month a block is removed, and a new one is bolted in its place. Biologists examine the block in the laboratory and compare it with those removed from the same spot at earlier dates. They can thus determine whether borer population is rising or falling.

The Teredo traps consist of 30 shingles bolted together. Since the borers refuse to cross a crack, they confine activity to a single shingle. When the bundle is unbolted, whole specimens may be removed, examined, and identified.

Test boards are kept at over 400 stations, and traps at scores of others. Maintenance of a board costs about $5 a month and a few companies pay for this service, but the great burden of expense falls on the laboratory. Test boards occasionally reveal a tremendous upsurge of borer population. In severe cases, as many as 100 Teredos have been found boring within a single cubic inch of wood. Such cases demand instant attention. Several times Clapp has found it expedient to telegraph dock owners quickly to remove all valuable goods from their property because their docks were in danger of collapse.

Once test boards indicate that borers are at work on the piling which supports a large dock, a diver goes down to make an examination. Some of the divers who work for Clapp are so learned that they even know the Latin names of the commonest borers. With astonishing accuracy they can estimate the amount of damage and from this the structural strength of supporting material left under the dock can be calculated.

Corrective measures are determined by local conditions. Where damage is severe, piling must be replaced. Some times concrete corsets are poured around partially damaged piling. Sometimes they are covered with metal sheathing. Damage to the vast, $25,000,000 Army Base in Boston was so severe that Clapp recommended that bulkheads be built which would completely enclose the substructure of the dock, and that fill be then pumped in. This fill prevented further activity of the borers, since ready access to salt water is necessary for their existence.



The exterior of a badly bored pile gives an appearance of solidity

If timbers in new construction are pressure-treated with good quality creosote they get complete protection. But in some cases the quality of creosote is so low and method of application so bad that even this treatment is valueless. The Clapp Laboratory tests the protective power of these materials. Through ignorance or false economy, hundreds of thousands of untreated piles are still being used in United States harbors. As a result, docks last only a third as long as they should and must be replaced often.

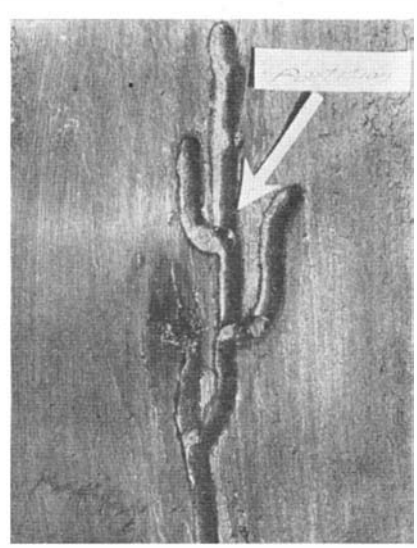
Still, one good word can be said for marine borers: without them the world would have no open harbors. Long ago harbors would have been clogged with rotting driftwood if the borers didn't destroy this debris.

The laboratory which is fighting the marine termites practically single-handed sends no bills. If clients—which include oil, railroad, and steamship companies—are satisfied with work done for them, they assess the value of service rendered and send checks accordingly. As a possible commentary on human nature, note in passing that the laboratory always totters uncomfortably on the verge of bankruptcy. Yet William F. Clapp will have things no other way.

"FRIENDS are always attempting to make me change my ways," says this genial biologist. "They want me to keep books and send bills and do things like that. But I'm damned if I will. I am a biologist, not a bookkeeper."

If a check arrives and Clapp feels that he has not earned the sum sent, he returns it. Officials of a large sugar company called for advice about a new dock. A telephone call saved them thousands of dollars and they sent a $500 check in appreciation. Clapp returned it. No five-minute telephone call, he contended, could be worth that much. Another time he refused an annual retainer of $15,000 from a company which made a wood preservative.

The pleasant, blue-eyed biologist has done practically everything to the Teredo except eat one. He hopes to get around to this some day. Meanwhile he goes along adding up new facts whose application will save millions of dollars. The laboratory had a sizeable deficit last year. It took in $11,000 and spent $13,000. But Clapp is not deeply concerned. "If your work is good enough," he feels, "people cannot afford to let you fail."



A Teredo tunnel in a laminated block, showing the partition always left when burrows pass each other

OUR POINT OF VIEW

Battle is Joined

HOW long World War II may last is anybody's guess. How difficult it is going to be for the United States is a different matter. Though not involved, we shall, nevertheless, be faced with a problem of defense against forces that are insidiously subtle. It is not our war, yet our fight to stay out of it will call into play all our forbearance, all our common sense, all the skill of our government.

As this is being written, the war in Europe is but a few days old. Radio and the newspapers have, however, given us already a vast amount of propaganda and counter-propaganda. One side of this war behind the war will have little effect on the individual for he will have formed his opinion prior to the outbreak of hostilities, but the propaganda from one's chosen side will tend to strengthen his belief in the righteousness of one cause. Inflammatory rumors will have their influence. Logic may be forgotten and emotion will rule. Hatred may become a neurosis, and the multitude may then clamor for blood, may insist that we enter the fight with men and guns. This we must guard against with all the might of whatever logic and sane thinking are left to us.

The United States is today in a fortunate position in respect to world politics and power. Our foreign commitments relate wholly to the American hemisphere. We have a battle fleet second only to that of Britain, and a large program of ships building and planned. A plan has been launched to train thousands of air pilots each year, and the personnel of our Army and Navy have been increased and rendered more efficient. More planes have been ordered to be delivered over a period of years to our military forces. Mechanization of the Army is proceeding with the efficiency that comes of deliberate care. Construction of scores, perhaps hundreds, of new American-type tanks—the best in the world—goes on apace. Slowly all infantrymen are being equipped with the world's finest rifle, the Garand semi-automatic.

The so-called "Stock Pile" Act, passed by Congress last spring, is enabling us to store up necessary vital products against a time of need when imports of them may be cut to a point lower than is at present possible. A War Resources Board has been formed of scientific and industrial leaders. Industry has long since been so organized that, if war should be forced upon us, each plant could quickly and efficiently go on a war-time footing. "Educational orders" have been given to many of them. Other things, important to us in war, have been mentioned recently in these pages. For example, there is the new process of molding airplane fuselages, which would increase our plane production enormously. Another is the sizeable supply of manganese from Cuba.

This magazine has long been a proponent of the philosophy of "preparedness for peace" and believes that the above review, sketchy though it be, indicates that particular and important kind of preparedness. Our might is vastly greater than in 1917, our organization so superior that there is no comparison. Hence, it is our belief that no nation will wittingly antagonize us, insolently dare us to go in on the opposing side. It is ourselves that we must watch lest we become dupes of silver-tongued agents who would embroil us in troubles out of our own bailiwick. We may give our sympathy—which is of the heart—where we will; but through it all we must keep our heads.—*F. D. M.*

Communication

AT first thought it would seem that the peculiar techniques of radio broadcasting—spot news, high-geared commentators, and so on—would give the whole world a grandstand seat in the event of war. But when the situation grew tense in central Europe, when fateful September 3 rolled around, the humming of the air waves brought thinking people to the realization that a communicating system was more than falling down on a job; it was providing a medium whereby misinformation strode side by side with information, and no sieve was offered through which they could be separated.

The preceding editorial hints at the propaganda possibilities of radio. But there is much more to the story. Operation by belligerents of stations under faked call letters, spurious dispatches, "blanketing" of legitimate stations—all teach us that we will do well to take radio news broadcasts, at least for the duration, with more than the proverbial grain of salt.—*A. P. P.*

Howling For Knowledge

A DOZEN years or so ago it was ascertained by means of polls conducted in the interests of the press that the branch of science which "pulled" hardest with the general newspaper-reading public was the one having the least practical usefulness—astronomy.

This startling discovery astonished the newspaper world. Since the press is the reverse of stupid, it gives the public just what is asked for and it therefore greatly increased its regular ration of features and news items on astronomy. This astronomical emphasis has been going on in the press for a decade or so and now it is bearing a heavy crop of fine fruit. The masses, and no longer merely a limited number of better-than-average educated enthusiasts, have now become strongly astronomy conscious.

In Chattanooga a small group of advanced amateur astronomers recently pooled their efforts to make possible a public observatory, whereupon thousands and thousands of people—just average "folks"—visited and continue to visit that observatory. Mountaineers have tramped in from the distant hills to see the stars through a large telescope for the first time in their lives

Not long ago David Dietz of Cleveland, science editor of the United Press, a man who has one foot in astronomy, the other in the newspaper world, decided to make a test of interest in astronomy among the masses and put on a public star party. Ten telescopes made by amateur astronomers in Cleveland were rounded up, placed in a public park, and directed at different celestial sights; one at Mars, another at Jupiter, and so on. Previously the event was announced in local papers. Would the party be a failure? Would the people take one look and amble off home? Would they come at all?

More than 5000 people stood in line till after midnight awaiting their turn to see what these objects, about which they had been reading in their papers for years past, look like. Patiently? No. Cleveland had to send two squads of police to keep them in line. Pop venders appeared out of nowhere and did a rushing business. When, at 1:30, the last eager star-gazer left the park, it resembled a battle-field, littered with paper, Crackerjack boxes, bottles.

Only a howling mob? Yes, but not a disorderly one—just eager. Only tabloid readers? Probably largely so. Is that bad? No—all to the good!

These successes give answer to those persons, schooled but essentially ignorant, who still insist on rating everything on a basis of its practical usefulness. It's a mighty good sign when 5000 of the plain people will stand in line and yell "Hurry up" in order to get a better idea of man's place in the universe; for that is suspected of being the real philosophy behind it all.—*A. G. I.*

Hunting The Mesotron

This Recent Addition to the Fast-Growing Family of Sub-Atomic Particles has Already Created a Place for Itself in Physical Theory and Experiment

By CHARLES W. SHEPPARD

WHEN confronted with the ever-mounting clutter of assorted atomic and sub-atomic particles brought to light by physicists in recent years, one naturally tends to be astonished when still another comes upon the scene. One may wonder: Do scientists go about hunting for these particles as might a bug collector hounding down a specimen, or do the particles merely fly in through the window one day and present themselves? Let us consider, for example, the latest problem particle in physics—the mesotron.

Although there has been considerable controversy as to where it is found in nature, it is now known that the mesotron occurs only in the cosmic rays. These rays, which rain in upon us constantly from outer space, have been known for many years. Nevertheless, the question as to just what they were was not settled until scientists turned to the Wilson chamber with which they proposed to study their true nature.

The Wilson chamber consists of a shallow glass cylinder covered with a glass plate. The interior contains a small amount of liquid, such as water or alcohol, which evaporates, filling the chamber with vapor. In the bottom is a piston which, when suddenly pulled out by a suitable mechanism, causes the vapor to expand and condense. If the expansion is very carefully adjusted so that condensation just fails to occur, any electrons or other charged particles which traverse the chamber will leave faint tracks of condensed vapor in their wake. By photographing these tracks, much can be found out about the nature of such particles. For example, their velocities can be found if the chamber be put between the poles of a large electromagnet. The effect of a magnetic field upon a moving charged particle is to cause it to be deflected in a direction perpendicular to the magnetic field and to its original path. Thus the track will be bent by the magnet into a circle. The radius of the circle is proportional to the momentum of the particle and, since momentum is the product of mass times velocity, knowing the mass, the velocity can be found.

At first, experimenters merely set up their chambers and expanded them at regular intervals, hoping to catch cosmic-ray tracks by accident. Considerable improvement was made in getting photographs when Geiger counters were used. These instruments consist of a thin metal cylinder surrounding a wire and put inside an evacuated tube. High voltage is connected between the wire and the cylinder and adjusted until just below the point at which a discharge will occur. If a cosmic-ray particle shoots through the tube, the discharge is set off and can be made to trip an electrical circuit, expanding the chamber. With such an arrangement, it is possible to catch a cosmic-ray track at every expansion.

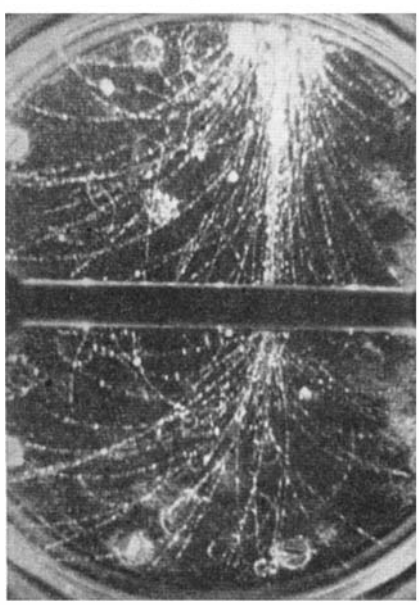


Figure 1: Two cosmic-ray showers, one in the chamber wall and one in the plate, show that particles from showers produce showers. Each particle has an energy of several billion volts. (See the text below.)

In practice, two counters are used, placed one on each side of the chamber and connected in such a way that the chamber expands when the particle goes through both. Thus, the chamber operates only when a track goes right through it.

The study of cosmic rays with the Wilson chamber was immediately fruitful. When a barrier of lead was put into the chamber, many pictures showed a strange phenomenon. A cosmic-ray particle entered the chamber from above and went on into the lead plate. It emerged from the other side and with it, like an explosion, came a regular forest of other particles (Figure 1). Such occurrences are called showers.

Up to this point, the result had been quite straightforward. There was good reason to believe that the tracks which were observed were caused simply by electrons. In particular, a study of the shower particles showed that those produced by showers could themselves produce showers, and their energy loss in going through the lead plates showed that all were electrons. However, the many workers on the cosmic-ray problem frequently observed other particles, and although their tracks looked just like electron tracks, they behaved in a different manner (Figure 2). To understand why the scientists were puzzled by these other particles, we must consider how charged particles lose their energy in traversing matter.

LET us consider first a fairly heavy particle such as the nucleus of a hydrogen atom, called the proton. Since the distance between the atoms in a plate of lead is about 100,000 times the size of the proton, the latter cannot lose energy by friction in passage through it, as would a bullet in a piece of wood. It is known that almost all the energy loss which a proton suffers is due to the electrical forces that it exerts on the electrons in the material through which it passes. About thirty volts of energy are needed to pull an electron from an air molecule. The number of these dissociated air molecules, or ions, can be measured and it is found that, in air, a proton of 1,000,000 volts energy creates so many of these ions that it loses almost all its energy in less than half an inch of air. In the case of lead, it will scarcely penetrate at all. Energy loss by ionization, as this type is called, is characteristic of heavy particles which do not move with very high speeds. Although the process is very complicated, it has been found that the energy loss is greater the slower the particle travels, and a measurement of the rate of energy loss gives an approximate idea of the velocity of the particle.

A totally different type of energy loss is also known. Particles such as electrons, which are light but travel at high

speeds, lose their energy by giving out electromagnetic waves when they pass through matter. This is how the rays are produced when the electrons in an X-ray tube strike the target. This type of process is called energy loss by radiation.

From what has just been said one can see that a study of the way in which a charged particle loses energy should give quite a bit of information about it. Such energy-loss measurements were attempted but were hard to make. The energies of cosmic-ray particles run in billions of volts. Such particles move so fast that none but the largest magnets will bend their paths enough to permit measurement. However, careful work gradually yielded the necessary information. As the measurements slowly accumulated, suspicion grew into certainty. Those tracks which produced, or were produced by, showers lost energy in just the way that electrons may be expected to do and were undoubtedly electrons. On the other hand, those tracks which occurred without showers were different, for they had a penetrating power very much greater than any other charged particles heretofore known. Of the many experiments to demonstrate this penetrating power, one of the most spectacular, in which the particles were made to pass through more than seventeen inches of lead, was made by Street, Woodward, and Stevenson, at Harvard University.

In 1937, Dr. Carl Anderson and Dr. Seth Neddermeyer, of the California Institute of Technology, put forward a tentative explanation in a paper published in *The Physical Review.* This paper contained a plot of the energy losses of cosmic-ray particles, showing how the non-shower particles lost much less energy than the shower particles (Figure 3). Let us suppose, they said, that the unknown particles are heavier than electrons but lighter than protons. Then particles of a given momentum will travel faster than protons and not lose much energy by ionization. On the other hand, they would not travel so fast as electrons and would not lose much energy by radiation. This would explain their low energy loss or great penetrating power.

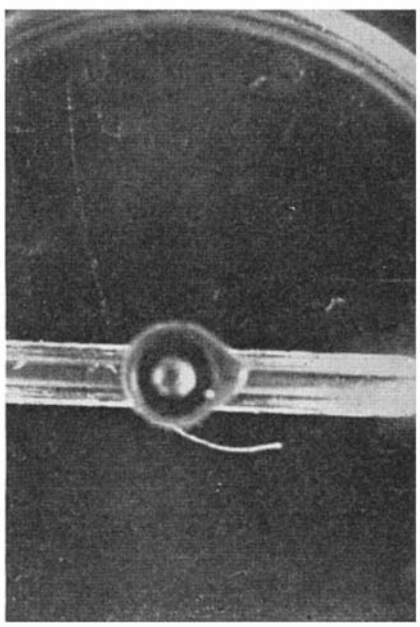


Figure 2: **"Picture" of a mesotron. The particle comes in with high speed, making a very faint track, slows down in the central plate, and emerges going more slowly, as is shown by the heavier track as well as by the sharper curvature**

In order to substantiate their theory, it was thus necessary to determine the mass of these particles. The difficulty lay in the fact that only the momentum can be measured when particles are deflected by a magnet. The mass is known only when the velocity can also be found. Several workers at once attempted to measure the velocities of the unknown particles by the following method:

A charged particle traversing a cloud chamber leaves a track because of the ions it produces in its path. The vapor in the chamber prefers to condense on these ions, and with the right expansion, every ion picks up a tiny droplet of condensed vapor. If the expansion can be delayed a fraction of a second after the particle passes through, the ions will have time to drift apart so that the droplets can be counted with a microscope. If the number of ions in each centimeter of track is counted, the rate of energy loss can be determined and this will give an approximate knowledge of the velocity of the particle. Such measurements are actually a good deal more difficult to make than a description would indicate. Conditions must be just right and not every picture will do. However, in 1937, Street and Stevenson, and, shortly afterward, Anderson and Neddermeyer, obtained the pictures they were looking for and forged the last link in a chain of evidence extending back over several years. Measurements of the mass of the particles from these pictures showed that they were somewhere between one and five hundred times as heavy as ordinary electrons. Several suggestions were made for naming the new particle and Dr. Anderson's suggestion of *mesotron* received the most support.

SCIENTISTS had scarcely had time to inquire as to what place there was for the mesotron in existing theories when a bolt from the blue came in the form of an already existing paper in the rather inaccessible *Proceedings of the Physico-Mathematical Society of Japan.* In this paper, published almost two years before the discovery of the mesotron, the Japanese physicist, Yukawa, had announced a theory explaining the force of attraction between the neutron and proton. The theory stated that these unknown forces holding the atom together could be explained if one assumed that there existed a new particle with the charge of an electron but of larger mass. If, as many scientists believe, the Yukawa particle actually is the mesotron, then not only is an experimental discrepancy accounted for but also a vacancy in theory is filled by its discovery.

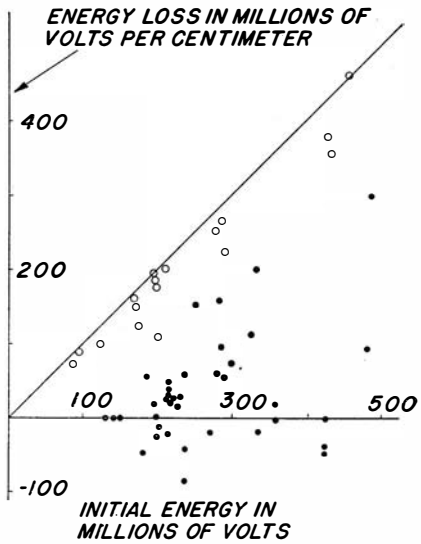


Figure 3: **Principal clue to the existence of the mesotron. Diagonal line represents the total loss of energy in one centimeter of platinum plate. The circles clustering close to this line are electrons. Dots clustering near the bottom of the graph are mesotrons**

Needless to say, the appearance of the mesotron upon the scene has stimulated the whole field of cosmic-ray research to new activity. Experimenters are redoubling their attempts to make accurate measurements of cosmic-ray tracks using larger magnets and Wilson chambers than those formerly employed. Thus more precise information will soon be obtained with such apparatus.

Let us now return to the question we made at the beginning. Is particle hunting a sort of glorified insect collecting or does the physicist find the particle one day at lunch in his soup? In the first place, both alternatives place an undue importance on the particle itself. Such a discovery is never merely a new head to hang on the wall of the physical laboratory. Instead, it invariably represents an important contribution to physical theories and thus frequently extends human knowledge in many different directions at once. Let us consider the senior member of the "tron" family, the electron. This particle is a crucial link in almost all the physical theory developed since 1875. It is safe to say that, without our knowledge of the electron, we would have no X rays, no radio, and no long-distance telephone. Perhaps one day, the mesotron will be as indispensable.

Could We Defend Our Ports?

An Imaginary Attack on a Mythical Port Shows Sort of Action That Would Take Place

WHETHER or not important American ports are sufficiently well fortified to stand off a possible invasion remains an open question. Only an actual attack upon one of those ports would provide the answer. The drawing on the opposite page is presented as an example of what might happen but, unfortunately, military strategy is not so simple as that. With this drawing before us, we still must lean heavily upon past military lessons and experience.

Bombing planes cannot cross the wide oceans that surround us and still deal any effective blows against us. Hence, any invader would have to depend upon only those planes which his carriers could bring. This immediately nullifies any belief which he might have that the airplane has changed naval warfare conditions radically since 1915. In that year, the British fiasco at the Dardanelles proved rather conclusively that it is futile to launch a naval attack upon land fortifications.

We are here concerned not with why an enemy might attack us nor how he would get through our first line of defense—the Navy—but rather with the possible reception he would get were he suddenly to appear on our "doorstep." For this purpose, we have shown mythical Smith City, the details of which are bunched and hence thrown out of perspective for obvious reasons.

As soon as the enemy's fleet nears the city—which might not have much warning—preparations for the defense of the port will get under way according to plans long before worked out. Necessarily, these plans include bringing up more guns and equipment, plane detectors, range finders, searchlights, and many additional men from camps near the city. Firing of anti-aircraft guns would begin long before the fleet itself is in sight. Its planes, based on carriers left perhaps 75 miles out at sea, will attempt to destroy gun emplacements in the city's forts. Doubtless, they would resort to the practice of dive-bombing, an American trick learned by foreign aviation, oddly enough, from an American moving picture, "Hell Divers," several years ago.

This surprise attack from the air might cause some damage, but the organization of the defense would, nevertheless, proceed rapidly and efficiently. All available units of all our armed forces—Army, Navy, and Air Corps—would be co-ordinated and unified under an appropriate commander. He would keep track of, and direct the movements of, the additional forces coming up from the rear, most of which is motorized and some, as in the case of the 12-inch and the 16-inch guns, on railway mounts. These latter large guns would be run in on the railroad spur shown at the right of our drawing. The 16-inch guns on railway mounts, as well as those of the forts, would be able to match anything the enemy capital ships would have, being able to throw one-ton shells for a distance of about 40,000 yards.

Against the enemy's airplanes would be directed the fire from several types of guns. Most important would be the 3-inch guns which fire about 25 high-explosive shells per minute to a height of 24,000 to 28,000 feet. Until 1938, we had only a few of these rather small guns. In that year we added about 340 of them to our armament, and since have added more. Another anti-aircraft gun which the defending forts would use is the 37-millimeter gun. This mobile arm fires explosive shells weighing approximately a pound and, being loaded with clips of five and ten shells, has almost machine-gun speed of fire. Furthermore, low flying planes would meet deadly streams of metal from 30-caliber and 50-caliber machine guns. The Spanish civil war apparently proved that machine guns, as contrasted to those firing explosive shells, are ineffective against modern, metal-clad planes. In spite of this fact, it is believed that these efficient machine-guns, properly controlled and operating in groups, could cause serious damage to planes.

ONCE an enemy plane is detected by the defense, an ingenious range finder, shown in the drawing near the anti-aircraft batteries, would go into action. This finder is practically automatic. As an observer moves it to keep its widely spaced cross-hairs squarely on the enemy plane, that movement actuates gun-pointing equipment to make the guns follow the plane's movements closely.

As for the fleet itself, wariness would characterize its actions because of the lessons of the Dardanelles. The enemy capital ships would form a line of battle just beyond the range of the largest guns of the forts. The advantage lies with the land guns because of their permanent emplacements which give greater stability and because their fire-control stations can more accurately plot a moving ship's position. These fire-control stations — shown on the drawing in both Fort Left and Fort Right—form the bases of triangles while their converging lines of sight make the apex of that triangle. The exact position of the ship at the apex is therefore easily calculated, in the plotting room of Fort Right, by the mathematical process of triangulation. Planes spotting shell bursts among the enemy ships, and also "tracking" those ships to predict their movements, would provide further data.

Since the enemy's principal purpose would be to get his capital ships close enough to deliver his 14-inch or 16-inch shells in the forts, he might try to sneak in under cover of a smoke screen. This screen would be laid by squadrons of destroyers which would dash in closely in a sweeping curve, firing their smaller guns furiously. The high speed of these destroyers increases the possibility of their escape but, even if some of them are destroyed by gun fire, their loss is not to be compared with that of a capital ship. It is during their dash close inshore that the secondary guns of the defenders, hitherto useless because of their shorter maximum range, must go into feverish action.

Our drawing has its necessary limitations. We have shown, for example, only one small submarine boat net and a mine field that is actually too limited for practical purposes. These things are more symbolic than actual, for we wished to show only the essentials. In real warfare, far more ships and guns, mines and nets, planes and anti-aircraft guns and detectors would be in such an action. Also there are many other factors, too confidential or too speculative to be mentioned here, that would have a bearing on the fight. In any case, it is believed that an attack of this sort would result in a stalemate. This does not mean that our ports are invulnerable. They aren't. It is only our ability to draw upon an immense hinterland for enormous support which could save us in such a situation. We do need more large-caliber guns, more and larger anti-aircraft guns, and many other important things—but that is another story.


DEFENSE PLANES "SPOTTING" FOR BATTERIES
AIRCRAFT CARRIERS ABOUT 75 MILES BACK OF BATTLE-SHIPS
DEFENSE PLANES ATTACKING AIRCRAFT CARRIERS
CAPITAL SHIPS BEYOND THE RANGE OF FORTIFICATIONS
EXTREME RANGE OF SHORE DEFENSES
DESTROYERS LAYING A SMOKE SCREEN
EXTREME RANGE OF SHORE DEFENSES
ENEMY PLANES UNDER FIRE OF ANTI-AIRCRAFT GUNS
SHOAL
DISTANCES OF 40,000 YARDS OR MORE IN EXTREME RANGES
EXTREME RANGE OF CAPITAL SHIPS
FORT LEFT
FIRE CONTROL STATION
SECONDARY BATTERY FIRING ON DESTROYERS
RAILWAY ARTILLERY
PLOTTING CAR
FORT RIGHT
MINE FIELD
PLOTTING ROOM
FIRE CONTROL STATION
ANTI-AIR-CRAFT GUNS
FIRE DIRECTING EQUIPMENT
LONG "BASE LINES" GIVE IMMENSE ADVANTAGE TO DEFENSE IN RANGE FINDING
FIRE CONTROL OR "BASE END" STATION
ANTI-SUB-MARINE BOAT NET
ANTI-AIRCRAFT GUNS
SMITH CITY
NAVY YARD
STRATEGIC AREAS UNEXPOSED TO NAVAL GUNFIRE
LOGAN DEAVIS

Eclipsing Binaries

A Striking Example of the Extent to Which the Astronomer, Armed with but a Few Observational Data, Can Sometimes Go in Unraveling Puzzles

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

IT may be questioned whether there is really a "royal road" to the solution of any problem of nature; but some routes do lead us, with less difficulty, deeper into the regions which we desire to explore.

One of the most important of these routes, in our search to understand the stars, is found in the study of the pairs which eclipse one another. It has long been realized that from good observations of these systems we can find out things not directly accessible in any other way, such as the real sizes of the stars, their densities, and the actual brightness of their surfaces.

But even the finer details of the light-curves, which might almost be called the "embroidery upon the main pattern," are singularly informative.

For example, when the brightness of an eclipsing star (that is, the combined light of the pair, which could not be seen double in a telescope 50 times more powerful than any ever constructed) has been accurately measured, and the light plotted against the time, it is found that, between the deep dips arising from the successive eclipses of each star by the other, there is a smaller, steady variation. Half-way between the eclipses, the light is brighter than where the eclipses are just over or just ready to begin.

The explanation of this behavior (which was first noticed in the bright star Beta Lyrae) has been known for almost 50 years. When the component stars are close together, each will be distorted by the tidal forces arising from the attraction of the other. This will make them egg-shaped, with the long ends pointing at one another. As they revolve in their orbits, about their common center of gravity, they will rotate at the same rate, and continue to point toward one another. Half-way between eclipses, where the line joining the stars is at right angles to us, we will see them broadside on. At the middle of eclipse (if the orbit is edgewise toward us) we will see them end on (one behind the other), and just outside eclipse they will be nearly end-on. Half-way between eclipses, therefore, the star-disks will have a greater apparent area than just outside them, and, naturally, we will get more light.

This ellipticity effect has been found in dozens of stars—indeed, in almost all cases when the observations of light are accurate. We might expect to find it bigger when the stars are very close together—and the eclipses consequently occupy a considerable part of the whole period—than when the eclipses are short and the stars far apart; and this actually happens.

The shapes which stars, tidally distorted by their mutual attraction, would assume can be calculated. The theory is fairly simple, in the first approximation (though it becomes intricate when the bodies are very close together). It is found that the shapes depend not only upon the masses, radii, and mutual distance of the stars, but also upon their internal constitution. If the material (supposed to be fluid, so that it yields freely to the tidal forces) is all of the same density, the elongation will be large; but if it is much denser near the center than at the surface the distortion is much smaller. In the extreme case where practically all the mass is concentrated at the center, it is only 40 percent as great as for a homogeneous body.

HERE then appears to be a royal road leading us to knowledge about the inaccessible interior of the stars. As long ago as 1912, Shapley applied this method, finding that the ellipticity of such stars, derived from observation, agreed quite closely with the values calculated by Sir George Darwin for homogeneous masses of fluid.

There was, however, one difficulty. The calculations just described had been made upon the assumption that the disk of each star (seen sufficiently magnified) would appear uniformly bright all over. Now the only star we can actually observe in this way is the Sun, and it does not look like this, but is only about half as bright at the edge as at the center. The reason is that the light which reaches us from points near the apparent edge escapes obliquely, and on the average comes from cooler layers nearer the surface.

We might expect some "limb-darkening" of this sort in the stars also. It is not hard to calculate its effects in the case of an ellipsoidal star. If there were two stars of the same size, shape, and average brightness, one presenting a uniformly bright disk and the other darkened so as to be very faint at the limb, it is found that the difference of brightness between the end-on and broadside-on presentations would be 60 percent greater for the "darkened" case than for the "uniform." An observed variation can therefore be produced by a "uniform" star of a certain difference in long and short diameters; by a "completely darkened" one for which this difference is only five eighths as great; and by a whole set of bodies of intermediate shape and intermediate degrees of darkening toward the limb. Unless we can find the degree of darkening in some other way—which is still very difficult—we are left in considerable uncertainty about the real shapes of our stars, and the actual internal distribution of density.

But now another royal road seemed to open up. If the stars are elongated as described, their mutual attraction will not be quite the same as if they were spherical. The effects of this have been known for more than two centuries. No perceptible change will be produced on an exactly circular orbit; but, if the orbit is eccentric, the line of apsides (passing through the points nearest the center and farthest from it) will slowly advance, in the direction of the orbital motion. The rate of this advance depends on the radii, masses, and ellipticities of the stars, and also on their internal constitutions, being a maximum if they are homogeneous, and falling to zero when all the mass is concentrated in tiny particles at their centers. This impossible, but theoretically limiting, case is known as the Roche model (from the name of its inventor).

If an eclipsing pair has a circular orbit, the alternate eclipses of each star by the other will come at equal intervals, and last equally long. But if the orbit is eccentric, both the intervals and the durations will usually be unequal. If the line of apsides is moving, the intervals between the eclipses will slowly change, swinging back and forward be-

tween two limiting values, and repeating these changes after a whole revolution of this line.

For most of the stars which have been observed, the orbit appears to be circular. But in a dozen or more cases unequal intervals between successive minima prove that the orbit is eccentric, and, in almost all these cases, the intervals are changing, showing that the line of apsides is moving. In two systems a complete revolution of the apsides has been observed.

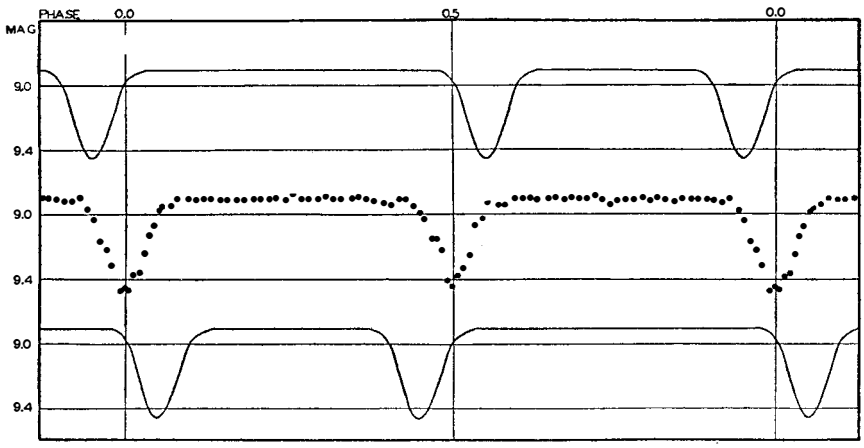
Knowing the rate of this motion, and the sizes and relative masses of the stars, we can calculate the degree of concentration of density toward the center. For the star Y Cygni—the first to be reliably observed—Dugan and the writer found, several years ago, that the concentration must be great.

But again the once-royal road appeared to be blocked. The theoretical calculation of the attraction of the stars on one another had been made for bodies of the shapes which they would have at their average distance apart; but no allowance had been made for changes in this shape.

NOT long afterward Walter went deeper into the mathematical problem, assuming that the two ellipsoidal stars were rigidly fixed in size and shape, but free to turn on their axes unevenly, and point a little away from each other at times. His analysis led to the remarkable conclusion that, in this case, the line of apsides moved *backward* while the two stars undergo vibrations such that their long ends oscillate to and fro about the line joining their centers (usually they oscillate with different periods).

Given his assumptions, his conclusions are mathematically sound; but, about a year ago, Cowling pointed out that real stars, being gaseous, would not behave at all like the "frozen," rigid bodies of Walter's theory. As the distorting forces changed, while the stars moved around their orbits, the mobile gaseous masses would tend to take new shapes, corresponding to the new forces; and this adjustment would be so quickly made that it is practically safe to disregard any lag in it, and assume that the shapes of the stars are determined by the forces at the moment, and are most elongated when the two are closest together. Working out the details—no simple task—he found that the apsides move forward, but at a little more than twice the rate originally calculated by the writer.

The theoretical problem has now, apparently, been cleared up. When the new equations are applied to the actual data—as has been done in detail for the best-observed stars by Sterne, and approximately, for a larger number, by the writer—it is found that, in every case, the central condensation is high.



Light curves of an eclipsing binary with eccentric orbit and rotating line of apsides. Phase in the orbit is measured toward the right. The distance between the two vertical lines labelled 0.0 represents a full period. Vertical distances represent the apparent magnitude of the pair of stars, a measure of their brightness. The dips in the curves are due to the eclipse of one star by the other. The center curve represents the average of all observations. In the upper curve the stars are at periastron (closest together) in the latter half of the period, midway between the two minima which occur closer together. The lower curve represents the situation 12 years later, when the elliptical orbit has swung halfway around, making periastron occur in the earlier half of the period. This variation of the time interval between eclipses is due to the greater speed of orbital motion when the stars are closest together.

However, the above diagram is not immediately related to the particular stars discussed and mentioned in the accompanying article. Rather, it is shown as "a very pretty illustration," as Professor Russell wrote in suggesting that it be reproduced, "of the changes due to locating apsides in an orbit," and it is taken from an article entitled "The Apsidal Rotation of GL Carinae," by Henrietta Swope and Harlow Shapley, in the *Bulletin of the Harvard College Observatory* for July 1, 1938 (No. 909). In the absence of Professor Russell in Europe the above explanation of the diagram was prepared by Prof. D. B. McLaughlin of the University of Michigan. Regular readers of Professor Russell's articles may be interested to know how the illustrations are selected: Sometimes he prepares rough sketches which are redrawn by this magazine's draftsman. More often the illustrations are selected by the editors, whose responsibility they therefore are

The motion of the apsides is never as great as 6 percent and usually less than 2 percent, of the value which it would have if the stars were homogeneous. It follows, approximately, that the central density of the stars is always at least 20 times as great as the mean density of the whole star, usually more than 50 times as great, and occasionally as much as 300 times.

So far as observations of this type go, the results are consistent—though a lot more observations will be needed to get more accurate data. But an alarming discrepancy now appears between the results of the one method and the other. The two royal roads end in different places—one indicating that the stars are not very far from being of uniform density, and the other that the increase of density at the center is very great.

The answer to this puzzle comes from some theoretical work of Chandrasekhar, who found, six years ago, that a distorted star of this sort should be faintest at the ends, remote from the center, and brightest at the point nearest the center—the surface-brightness being proportional to the intensity of gravity as this would be observed by an imaginary inhabitant of the surface.

For such a body the difference in brightness between the end-on and broadside views is much increased—in fact, very nearly doubled. This was first pointed out, five years ago, by the late Dr. Takeda. His results were published (in English) in a Japanese scientific periodical, and escaped notice till the matter had been treated by various other investigators.

When allowance is made for this and for the effects of "darkening" (which operate almost independently) the discrepancy disappears. The fairly large changes in light which are observed between eclipses arise largely from the difference in brightness between the ends and the middle of the elongated stars—and are increased by the limb-darkening. The real shapes of the stars are not far from those of the Roche model—just as the changes in the orbits indicate.

Much more work remains to be done before this mine of information about the surfaces and the interiors of the stars becomes exhausted. Meanwhile, it is interesting to note that our present fairly satisfactory knowledge has been reached by the work of investigators coming from this country, England, Germany, India, and Japan.

Specially equipped Stinson Reliant plane picking up a bag of mail "on the fly"

AIRMAIL FOR SMALL TOWNS

Pick-Up and Delivery Without Landing . . . Made Possible by New System . . . Can Bring Fast Mail Service to the Most Remote Areas

By DR. ALEXANDER KLEMIN
In Charge, Daniel Guggenheim School of Aeronautics, New York University

DIRECT airmail service to small cities and towns, previously reserved for large centers of population where the volume of business warrants large airports and mail-handling facilities, is now daily available to 58 localities throughout Pennsylvania, West Virginia, Ohio, and Delaware. Through development work by All-American Aviation, of which organization Richard C. du Pont is president, an airmail delivery and pick-up system invented by Dr. Lytle S. Adams has been reduced to practical operation. Flying the air-ways in specially designed and equipped ships, "sky mail clerks" are now able to make deliveries and to pick up mail without the necessity of landing. At the time of writing, the system is in operation with six experienced pilots, some of them of national reputation, and four "sky mail clerks" constituting the flying personnel.

The success of the system, and the regularity with which the service is carried out, indicate its entire feasibility. There is no doubt that it can readily be extended to other sections where its advantages are desired.

While full technical details of the exact operations of this new system have not as yet been released, the accompanying photographs and following description serve to give the fundamentals. The ground equipment necessary consists merely of two steel poles, 30 feet high, set in concrete foundations 60 feet apart. Each pole is topped by a brilliant orange marker. Stretched between the poles, and attached by spring clips, is a transfer rope from which is suspended the mail bag to be picked up.

In the planes used for this service, all standard interior equipment has been removed except the pilot's seat, thus making room for mail bins, pick-up gear, and a seat for the clerk who also is responsible for the operation of the mail-handling apparatus. With this relatively simple setup it is possible to deliver and

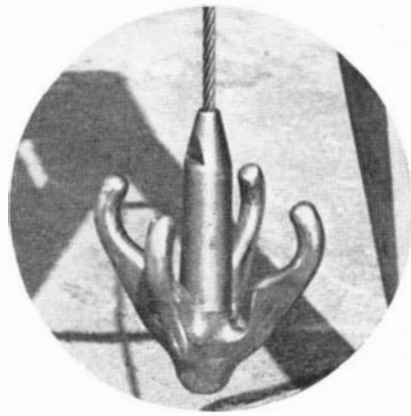
pick up mail while flying at a speed of between 90 and 110 miles an hour. Since speed is the essence of airmail service, it is interesting to note here that, flying 1540 miles daily and making 75 pick-ups to serve the 58 communities along the route, All American Aviation's planes are carrying on a regular schedule at a average speed of 100 miles an hour even under adverse weather conditions. Since the stations are from five to 22 miles apart, such service could not possibly be maintained if it were necessary for the plane to land at and take off from every station.

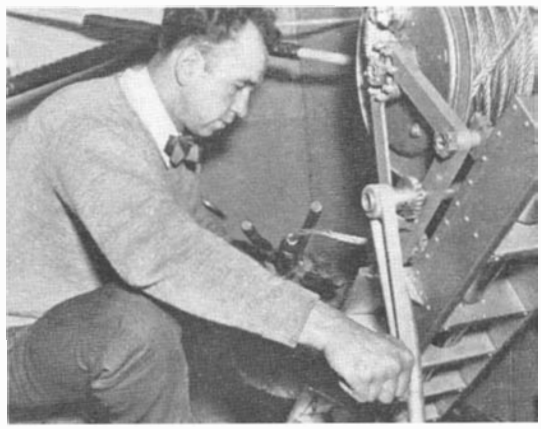
Deliveries and pick-ups are made in one trip through each station, the operation being as follows: The clerk lowers by hand the bag for delivery, which is linked to the plane by a rope ending in a release mechanism that is under the control of the pilot. He then lowers the grapple hook on one end of a cable that is wound on a shock-absorbing winch in the plane. The pick-up cable extends from the bottom of the fuselage about two feet forward of the delivery rope and the two lines are prevented from fouling by their drag/weight ratios which give them different curves in space.

When the delivery bag is released by the pilot, before the plane reaches the two poles and transfer rope at the station, it falls clear of the pick-up cable. The plane then passes between the poles at an altitude of 50 to 70 feet above the ground. The pick-up cable then crosses the transfer rope and slides across it until the prongs of the grapple engage the rope and pull it free from the poles. As the grapple pulls on the transfer rope, the mail bag slides along the rope away from the grapple, a simple restricting fitting slowing up the travel of the bag as it approaches the end of the rope where it is checked. It is really this slide fitting, which absorbs much of the shock of contact, that makes possible this type of pick-up without impossing undue strain on the cable. The remainder of the shock is taken up by the absorbing mechanism in the plane. It is stated that the pick-up is scarcely noticeable to the occupants of the plane. Should the grapple or cable be fouled by an obstacle on the ground, a safety link in the cable will break, preventing any possible accident.

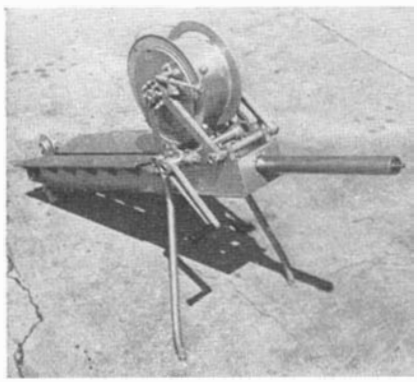
In present operations the pick-up load has been limited to 20 pounds, although loads up to 70 pounds have been successfully picked up in tests.

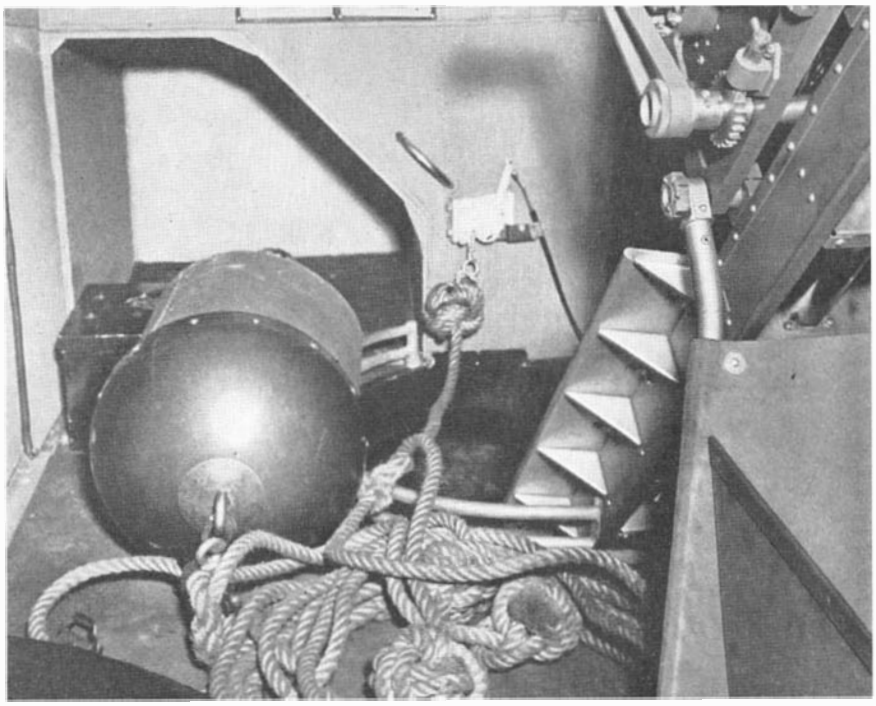
The mail bags used in this system have been so designed that they will trail smoothly in the air and also that they will withstand the shock of dropping at high speeds. As shown above, they consist of a smoothly rounded fiber nose with a rubber skirt attached and a mail container inside.





Above: The steel grapple with which airmail pick-ups are made. *Left:* A "sky mail clerk" operating the winch by means of which the bag of mail is reeled into the plane. *Extreme left:* Close-up of the combined winch and shock-absorbing apparatus which is mounted in the plane. The air-oil shock absorber operates when the grapple hooks into the line and prevents undue strain being imparted to the plane itself. *Below:* The fiber and rubber mail bag, showing the restricting fitting which slides along the rope and helps to absorb transfer energy





Looking toward the rear of the special airmail plane, showing a mail bag ready for delivery and, in background, the mechanical release operated by the pilot

Cancer's Mysterious Puzzle

Though Science Still is Baffled by the Problem of Cancer's Cause and Cure, Research Continues . . . Most Alluring Leads of the More Recent Years

By BARCLAY MOON NEWMAN

"PUBLIC interest in the cancer problem is now at the highest point in history," says Dr. James Ewing, one of our foremost cancer experts and director of Memorial Hospital, New York City.

This interest is only natural. We have become aware that cancer is by far the most important public health problem. Some 150,000 die each year in the United States from this perhaps most mysterious of all man's afflictions. Cancer, it is true, is curable—to a certain extent, especially if caught in the early stages—and many are cured, or more accurately, are treated successfully; but the fact remains that many more are not cured.

The great mystery is nowhere near elucidation—and on this point all experts agree. Why do some cells subtly begin to multiply aimlessly, to form an unorganized—hence cancerous—growth, which the body cannot control because the growth escapes from the unknown agents that normally keep all the tissues a unified harmony of structure and activities? Such is the problem, simply stated. Yet this simplicity is deceptive, for all man's enormous medical and bioknowledge is at a loss for the answer.

And so, any new clue to a possible answer is fascinating as well as distinctly promising. The discovery of substances which definitely have the power to induce cancer is the most promising of all recent leads—and surely the most startling.

"One of the most fruitful lines of cancer research in recent years has provided the demonstration that cancer may be produced at will in a majority of the animals treated, with a variety of chemical compounds. For the most part these compounds have been prepared synthetically and their molecular structure is known. They retain their activity undiminished after a high degree of purification. The cancers which may thus be induced experimentally are indistinguishable in their characteristics from the cancers which afflict mankind." So we are told by Dr. J. W. Cook, the English pioneer in the realm of cancer-inducing substances, who, with his coworkers at the Research Institute of the Cancer Hospital, London, has led the world in this line of research.

All illustrations courtesy United States Public Health Service

Using the fluroscope with X rays in examination of the chest for cancer. If there is a cancerous growth, a shadow will be discernible on the screen in front of the chest

The story of the discovery of cancer-causing chemicals begins at least as far back as 1775. In that year, the London surgeon, Percival Pott, remarked on the prevalence of cancer among chimneysweeps and pointed out the probability that soot is the significant factor. Soot, we now know, contains a number of tarry substances—hydrocarbons, or molecules made up of atoms of carbon and hydrogen. We now also know that Percival Pott was right so far as he was able to go with the science of his time. Some of the tarry substances of soot are inducers of cancer.

Later, other occupations besides the sweeping of chimneys were found to be plagued by significantly high rates of cancer. Skin cancer is frequent among workmen employed in the distillation of coal tar. Laborers who spread tar on roads; workers chronically exposed to shale oil and other lubricating oils; makers of certain dyes, particularly aniline dyes; spinners in continual contact with certain oils—in each of these occupations we observe a suspiciously high cancer rate: occupational cancer.

IN 1906, B. Fischer injected a dye known as Scarlet R into rabbit ears. The cells of the skin, after several injections, multiply abnormally, in a manner similar to cancer cells. But when these injections are stopped, cell proliferation ceases—that is, the growths are not malignant and so not truly cancerous. This work has been extended, and one outcome is the use of Scarlet R to hasten the healing of wounds. Another outcome, as we shall see, has led by a tortuous path into the field of true cancer.

In 1911, Peyton Rous discovered a chicken tumor which not only can be propagated indefinitely by transplantation from fowl to fowl—and hence a true cancer—but also can be induced by a mysterious agent or chemical extracted from the malignant tissue. In these labors, Dr. Rous collaborated with James B. Murphy, now Director of Cancer Research, Rockefeller Institute.

As such facts were brought to light, a great question crystallized in the minds of cancer experts: Is a single substance involved—a lone fearful chemical which causes cancer? Great hopes, too, arose. Is the hypothetical chemical the sole cause of cancer? Perhaps, it was speculated, the cause of cancer is, after all, simple—and the cure likewise simple and near at hand. These hopes have been dashed. In their place, how-

ever, are definite advances toward the vast secret—for all that, the secret seems vaster than ever. Hope, if an inspiration to intelligent action, does bring results and newer, more firmly based aspiration.

In 1915, two Japanese scientists, Yamagiwa and Itchikawa, set forth a fundamental experiment. They repeatedly applied coal tar to the ears of rabbits. Malignant growths developed. Coal tar does indeed induce cancer. Yet coal tar is noted for the inestimably great variety of its components. To determine the guilty substance or substances would seem a herculean labor. Nevertheless, many investigators rushed to the task.

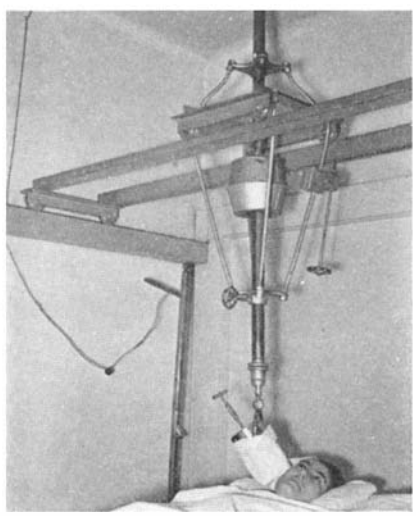
A decade later, in 1924-1925, E. L. Kennaway, of the Research Institute of the Cancer Hospital, London, produced cancer-inducing tars in the laboratory in one instance by heating acetylene in an atmosphere of hydrogen under pressure. Then an ambitious program of detective work was plotted at the Institute—for Kennaway's discovery indicated the probable chemical nature of the cancer-inducing material. Acetylene is a hydrocarbon, and the technic of the experiment apparently should yield only hydrocarbon derivatives of acetylene. Here was a priceless clue.

One by one, the known hydrocarbon constituents of coal tar were tried out on mice—a laborious procedure, involving months of work with each substance. Negative result followed negative result. The years began to go by. All the known fractions were separately tested, in vain. Still, the guilty agent was there in the tarry mixture—somewhere. A new conception of its potency arose. So rare, so difficult to find, the agent must be astoundingly potent in its action. Minute traces of it, beyond a doubt, could stir up a series of cellular changes having the fatal outcome of cancer.

BY 1930, however, Mayneord and Hieger perfected a special spectroscopic technic by which it is possible to relate the spectra of tars and tar fractions with their cancer-inducing powers. Certain spectra, or wavelengths, were shown to be characteristic of the tarry materials exhibiting the maximum cancer-inducing activity. A special group of chemicals soon became suspect. This group is made up of the more complex compounds of hydrocarbons—known as the aromatic hydrocarbons, and known to feature rings of carbon atoms all tightly fastened together, and with hydrogen atoms clinging here and there: all to make up an intricate molecule.

Particularly suspect was the hydrocarbon called 1,2-benzanthracene, apparently not a cancer-inducing chemical itself, but a molecule giving rise, under the proper spectroscopic conditions, to wavelengths of light impressively similar to those from tars definitely potent cancer-inducers. A logical step was next taken. Why not try the effect of chemicals having molecular structures very much the same as that of 1,2-benzanthracene?

The detectives were able to write down the formulas of the chemicals most suspect. The substances were rather numerous and many had never been seen. Dr. Cook rose to the occasion. He synthesized the desired undiscovered substances—a brilliant achievement because of the complexity of these many-ringed aromatic molecules. He also made available to his colleagues, by additional syntheses, the already discovered, essential molecules.



Treatment of a cancer with radium. During perhaps half an hour this treatment may continue, the patient feeling no particular sensation

As luck in science would have it, however, the first cancer-inducing agent to be turned up was not among those hydrocarbons which Cook's originality enabled him to synthesize before any other chemist. This fact detracts nothing from Cook's extensive pioneering which has turned up dozens of cancer-inducing molecules.

Alert and co-operating remarkably, Kennaway, Mayneord, Hieger, and Cook in the course of their researches reached an utterly formidable molecule—also formidably named, 1,2,5,6-dibenzanthracene. This substance they dealt with as they had with the others before. They dissolved it in benzene to make up a 0.3 percent solution. Twice a week they applied a drop to the skin of the backs of their mice. The weeks ran into months. Finally, in a large number of mice, small warts developed on the skin. The warts began to grow, many swiftly. Several frequently coalesced into a single horny mass, which, as autopsy proved, would push forth tentacle-like, hungry tissues extending down into the inner normal tissue. Cancer!

When, in the future, history is written with the correct perspective, the year of this observation, 1932, no doubt will mark the start of a major epoch in man's effort to survive on his planet.

And, according to Howard B. Andervont, of the United Public Health Service and Harvard Medical School: "This epochal observation, which was the outcome of a series of brilliant experiments performed by the English workers, is an example of the results that may be obtained by co-operative efforts."

DR. Andervont adds: "It is also an example of the way in which observations made in the one field of science may lead to important advances in other, unrelated fields, for the chemists who first synthesized 1,2,5,6-dibenzanthracene were not interested in cancer research." In 1929, an organic chemist, Clar, had reported a new and ready means of making this compound, with which chemists had been familiar for some time.

1,2,5,6-dibenzanthracene, however, soon lost its unique status—as the only known cancer-inducing molecule. Our Englishmen speedily found that 1,2-benzanthracene also was cancer-producing, though only feebly so. They identified the active constituent of coal tar in 1933: a chemical termed 1,2-benzopyrene. And, in the past few years, from their London laboratories has come a list of more than 30 chemicals clearly cancer-producing when painted on the skin of mice. All substances giving rise to occupational cancer contain a certain percentage of one or more of these agents or of their chemical kin.

Has the cause of human cancer been discovered at last? Not by any means. Dr. Cook states:

"We are not, of course, justified in inferring that human cancer is of chemical origin. All we can say is that there are a large number of experimental observations which are consistent with the view that the factor which initiates the onset of malignancy may in some cases be a chemical compound or compounds."

The very recent story of the developing science of cancer-inducing chemicals constitutes an amazing justification for Dr. Cook's judgment. The story is really stupendous—it involves wholly unexpected relationships among life's highly diverse chemicals, relationships that are as profound as life's deepest secret. It appears that the enigma, What is life?, will as readily be solved as the enigma, What is cancer?

What mystery is deeper than that of sex? The discovery of some of the chemical messengers, the hormones, which play powerful rôles in the development of man and woman has only

made the mystery more involved—despite popular rumors to the contrary. Now the mysteries of sex and cancer have been united. Now workers in the United States become the pioneers. Edgar Allen, Professor of Anatomy at Yale University's School of Medicine, with Dr. E. A. Doisy, in 1923 showed that female sex hormone injections can start certain tissues growing with astonishing rapidity. Also at Yale, and collaborating with Dr. Allen, other investigators—G. M. Smith, W. U. Gardner, L. C. Strong, and W. O. Nelson—have advanced far along these lines. The English school has reciprocated by establishing that some of the known cancer-inducing chemicals can, in special cases, act upon the body in the very same way as certain sex hormones!

LACASSAGNE was the first to report (1932) the production of true cancer by use of sex hormone. Mammary tumors developed in *male* mice after a lengthy series of injections of estrin, a *female* sex hormone. Large doses are required.

"This is a very significant observation," says Dr. Carl Voegtlin, Chief of the National Cancer Institute, United States Public Health Service, "since Little reports that in over 5000 mice in his colony spontaneous mammary tumors occurred only in the females and not in a single male."

Incidentally, the males take on certain female characteristics—and, like true cancers, the mammary growths can be transplanted from the feminized males to either males or females. The cancers, Dr. Allen and his co-workers inform us, after transplantation will continue to grow without additional stimulation (by injection of more hormone). Hence, we must not forget, the genetic or hereditary factor may always play a part in cancer, however induced. This consideration is a whole science in itself—another imposing history, fascinating too.

Not only mice respond to sex hormone injections. Such injections produce abnormal growths in rats, guinea pigs, monkeys. Some of these growths are typical cancers. Recently, the American Medical Association warned against the use of a certain cosmetic containing female sex hormone and pointed out the possible production of cancer by repeated application of the cream. The Association has also warned against promiscuous injections of female sex hormone in therapeutic measures. There is no doubt that human beings would ultimately develop malignant growths subsequent to long-continued treatment with such chemicals. Clinical results—in which non-malignant growths have begun to show up just before treatment was halted—confirm these forebodings. (The non-malignant growths cease development and generally recede harmlessly enough upon cessation of administration of hormone.) Where the unified investigations of sex and cancer will lead, none can predict. The future is unimaginably great.

There is a strikingly close resemblance between sex hormones and the particular cancer-inducing hydrocarbons discovered by the English scientists. Some of the cancer-producing compounds have hormone-like activity. Other physiologically active chemicals—including vitamin D—have molecular structures also strikingly like cancer-causing chemicals.

The X ray in action for treatment of stomach cancer, 1,000,000 volts now being used to get deep penetration, also to minimize skin burn

And so, naturally, there has arisen a theory that, in some weird fashion, the normal course of chemical transformations within the tissues may be upset and, out of an essential hormone or allied chemical, cancer-producing chemicals may disastrously emerge. This theory is still, for all its apparent plausibility, little more than a guess.

Yet there are other lines of approach to the problem—and they suggest the theory anew. One of the most powerful cancer-producing substances is methylcholanthrene. One of the acids found in bile has a molecule impressively like the potent cancer-producing molecule. The biochemist readily makes methylcholanthrene from bile acid—why may not the distraught tissue, fated to become cancerous? We as yet have no inkling of the truth.

There is even more to puzzle us—in fact, tremendously much more. A wax-like substance, cholesterol, is present in every cell of the human body; brain and other nervous tissue are especially rich in this chemical. Cholesterol is a member of the chemical family—of related or closely similar molecular structures—to which bile acids, sex hormones, and cancer-inducing chemicals belong. Now to this group of almost uniquely strange things we must add—as the biochemists show us—such outlandish molecules as certain violent heart-poisons (including digitalis), certain narcotics (morphine and its kin), toad poisons, certain toxic plant-molecules (saponins) which readily burst the corpuscles of blood—and which, because of their foam-producing power, once were widely used to produce foam on bottled beverages!

Four Japanese scientists—Yoshida, Otsuka, Nagao, and Kinosito—have made outstanding contributions to cancer lore. Their successes too, nevertheless, have served only to increase the entire mystery. Yoshida demonstrated that the Scarlet R molecule, used to accelerate the healing of wounds, can be burst to yield a cancer-producing molecule, which he identified. In a sense, it was disappointing to learn that this carcinogen is not a hydrocarbon—and so is not a member of the family of the carcinogenic hydrocarbons. The future would have looked much brighter if nature had decreed that only one general type of chemical can be cancer-producing. Many utterly different classes of molecules possess the dire potency.

IN fact, the so-called "azo compound" of Yoshida does not induce malignant growth of the skin where repeatedly applied or even where injected. The azo compound, fed or injected, produces cancer of the liver and bladder. According to Dr. Cook, a related azo molecule "was shown by Otsuka and Nagao to have a much more pronounced carcinogenic action on the bladder when administered to rats with their food, but no longer gave cancer of the liver." A subtle change in molecular structure makes a great difference.

Startlingly enough, Kinosita has shown that "butter yellow," a dye hitherto useful in coloring butter and other foods and similar in chemical structure to Yoshida's carcinogen, induces liver tumors in rats. Presumably, butter yellow is dangerous; hence its use in foods has been discontinued.

Today more than 50 different cancer-producing chemicals are known. Is there any property common to them all—besides, of course, their carcinogenic activity? No. And we can be sure that, in the gloomy light of the measureless dread of cancer, every conceivable property has been considered.

Is there any indication of how these substances produce cancer? No.

In a recent lecture subsequently published in *Science*, Dr. Carl Voegtlin gives us the conservative, present conclusion: "It seems wiser for the present to admit our ignorance concerning the mode of action of carcinogenic agents."

Man — Mechanical Misfit

In the Long Course of Organic Evolution Diverse Experiments Have Been Tried, Some Successfully and Some Not . . . Is Man Destined to Failure?

By G. H. ESTABROOKS
Head of the Department of Psychology at Colgate University

NATURE is not infallible. Far from it. She blunders along for a trifling 300,000,000 years to produce a gigantic race of dinosaurs—then scraps the lot. She puts in another 100,000,000 perfecting a type of mammal that makes the elephant look like a pygmy. Then, in a huff, she packs him off bag and baggage to the realm of fossils. The last 20,000,000 years she has been specializing on man and his ancestors. There are many of us who feel that she is just on the verge of losing her temper with this latest product. It may be a guilty conscience, but at times she seems to send in our direction what can only be described as a very dirty look.

However, we are not interested here in recounting the story of evolution. Rather we wish to draw attention to certain engineering problems with which nature found herself confronted. The production even of man is a tremendous feat, for the engineer builds with only one type of brick, the cell; and there are many billions of these in the human body. To be sure, they differ much from one another in form and function but they are still cells, microscopic in size, from which nature finally constructs such monsters as whales, elephants, or men.

Let us take a very brief glance at the nature of the animal. Fundamentally he is just a gasoline-carbon-burning engine and its basic problems are few in number. When carbon burns it simply unites with oxygen, produces energy in the form of heat and leaves certain waste products behind. So nature's great problem in building an animal-engine really subdivides into three smaller posers. First, get the carbon (food) to the engine. Second, guarantee a source of oxygen and, third, remove the waste. Three neat little problems on which nature has been working for 2,000,000,000 years and is just getting warmed up, so to speak. Of course, there are minor considerations as well. She has spent a great deal of time and energy perfecting the machine, as such. Also she has had to devote much "thought" to its protection, for some animals find tha the easiest possible way to collect a supply of food is just to eat up the fellow next door. Not all these problems have been of equal difficulty. At times we can see where the whole course of evolution has been held up for one or two hundred million years while nature's experts were trying to invent a suitable carbureter, or were completely changing the ventilating system. The fuel pump (heart) has caused no end of worry and the exhaust system (kidneys) is continually causing labor trouble. Yet, for all that, the machine runs and probably will be running hundreds of millions of years from now.

TAKE the question of the fuel supply. Difficult, to be sure, but not as serious as some of the others. Nature's first animals were tiny microscopic blobs of protoplasm. The ameba is a giant compared with these first attempts, but if we put it under our microscope we find that its food problem is simple. Its body literally flows around a particle of food, which then passes right through the body wall into the body itself and is there absorbed into the tissues. None of this nonsense about stomachs, mouths, livers, or such things. But life became more complex and, even in these single-celled animals, we soon find a definite "mouth" appearing and a stomach—really a food sac. For hundreds of millions of years nature was quite satisfied with this arrangement. The animal took in food through a definite opening, digested it in this food sac, and then expelled the waste *through the same opening.* The sea anemone with its waving tentacles is an excellent example of this stage in the food question, although this method applies also to much larger creatures such as the jelly fish and the Portugese Man-of-War. But it was inefficient, especially when we came to larger animals.

Much more practical was the continuous digestive tube which nature first brought in with the roundworm and has used for the past 700,000,000 years in all higher models. Here the food comes in at one end of the body and follows a continuous course until the waste is expelled from the other extremity. This is one-way traffic and nature could then add livers, kidney, bile ducts, and various types of glands all along the passage, guaranteeing the proper digestion of the food, the elimination of waste, and no worry about congestion caused by back traffic.

This matter of getting food in and waste out of the whole body was not such a serious problem. Somewhat more of a poser was the question of distributing the food, once it was within the body walls. In very tiny organisms nature trusted to the principle of diffusion: the digested food would leak through from one cell to the other. But this had very definite limits. As the animals grew larger she tried the idea of side tubes going out from the central stomach. These would convey food to distant parts of the body and then diffusion could get in its work. This idea was better but also called for improvement. In anything larger than a small worm it did not give satisfaction, especially in so far as waste products were concerned. So nature took a tremendous step and installed a fuel pump (the heart) which forces the food in under pressure and literally washes out the debris.

This fuel pump and the fuel lines (blood vessels) have been a continual point of worry to Mother Nature, with continuous alteration in design. The earthworm has half a dozen of these hearts, which are really only thickened and muscular arteries. Since then, nature has followed a continuous evolution until we come to the very complex four-chambered mammalian heart.

The matter of getting food into and through the body was, however, simple compared with the problems involved in the oxygen supply. Carbon is worthless as a source of energy unless an adequate supply of oxygen is always on hand, but how to get it into the body and then guarantee that each of the billion cells would get its share? All life started in the water and there is plenty of oxygen dissolved in normal water supplies. Nature's first answer was again to depend on the principle of diffusion. Gases or liquids will always tend to equalize pressure, if possible. There is less oxygen in a cell than in the surrounding water, so the oxygen in the water, because of its greater concentration, is pushed through the very thin cell wall into the cell itself. Once inside, it unites with carbon compounds, forming the gas carbon dioxide, CO_2. This is in much

greater concentration within the cell than in the surrounding water, so the CO_2 is pushed out again—a very neat little arrangement whereby the cell in question is assured of an adequate supply of oxygen.

However, this principle has very definite limitations. The cell or body wall must always be moist and must be very thin, otherwise this exchange of oxygen and carbon dioxide will be so hampered as to be inadequate for the needs of the animal in question. An animal the size of even a small fish needs such a thick skin to hold it together that diffusion is impossible, so nature found herself neatly checkmated in the matter of evolution until she could answer this problem of oxygen supply.

Here nature showed real genius. She already had installed a fuel pump in these primitive animals, which guaranteed a supply of blood-carried food to every last cell. Why not use this same pipe line system to get the oxygen around? Only how? The answer was hemoglobin, a red iron compound which colors your blood. This substance has the peculiar power of forming a very unstable alliance with oxygen. As it passes through your lungs, forced on by the heart pressure, it takes on a load of oxygen and then literally dumps it at whatever cell has the greatest need—that is, the least oxygen pressure. Only, of course, at this stage in the game nature hadn't even thought of lungs. All life was in the water. Lungs were several hundred million years away.

SO nature handed this task of oxygen transportation to the blood stream, in addition to its already important one of transporting food. In some relatively late models, such as the insect, the blood still has no responsibility so far as oxygen is concerned. In nature's improved model it had; but how was she to get the oxygen in the water to make contact with the blood stream? After much fussing about with her old idea of skin diffusion she hit on the gill slit. Here the water flows through the gills of the fish or other water animal, propelled by the throat muscles of the species in question. In these gill slits, as you can see by examining any fish, the blood comes very close to the surface of the body, being separated from the water only by the thinnest of skins. Here we again have the principle of diffusion. The oxygen is forced in through this skin because of its greater concentration in the water and the carbon dioxide is forced out for the opposite reason, thus guaranteeing an adequate supply of oxygen in the blood stream which transports it to the individual cells. The gill slits are the lungs of the fish, and nature was now able to proceed with evolution, having solved a major mechanical difficulty. Size was no longer restricted by this question of oxygen supply, formerly a limitation.

But increase in size immediately raised another question. You can't have animals 30 feet long which are just masses of jelly; you must have some form of girder on which to drape this mass of muscle, tissue, and blood. Obviously, bone of some sort was the answer. But given bone, then what? Should the skeleton be inside or outside the water animal in question? This question was so vexing to nature that she did it both ways and then sat back to watch results—is still watching results, in fact, very critically, for if man is chased off this earth the insect may do the job, and the insect has the outside skeleton.

THE reader will note that, in the accompanying article, the author personifies nature: nature thinks, nature makes plans, nature rejects, and so on. The reader is at liberty to take this literally or he may regard it more as a convenient manner of speaking. Since the time of Darwin the great majority of scientists deny outside planning and ascribe the amazingly intricate fitting of parts as the result of millions of years of slow accumulation of useful combinations. Every organism has the power to make certain adjustments to changes in the environment. It also has the power of adjusting itself while it grows. Organisms also vary from time to time with regard to particular features. Give this variable, adjustable organism, say, 50,000,000 years and the fossil evidence shows that sometimes (not always) it does take advantage of new opportunities and does advance with the times. Other types remain more fixed and stable than the mountains. The author, in his article, selects a few of the hundreds of forms known to science and shows what happened to those that did advance from fish to man.

Will nature really discipline man? Or will social man with his superior adaptability recognize and head it off? Just at present he is demonstrating (in Europe) the need of the slipper. Is he corrigible? Who knows?—*The Editor.*

This external skeleton has two tremendous advantages. Physical strength is a question of attachment area for the muscles and the external skeleton affords protection. The lobster tribe and many insects are incased in a shell which is "proof" to animals at their own level.

But, opposed to these advantages, is the problem of weight. If this casing is to be effective, then the animal is slowed up by its weight despite its extra strength. It is like the knight of old without his horse, or the heavyweight wrestler—dangerous customers if they can get you cornered, but not much of a problem if you take to your heels. And nature has discovered that the very best of all protection is speed. A hawk is dangerous to a sparrow but a swallow doesn't even notice him. Both hawk and swallow know he'd be wasting his time if he started on a race. Here many insects have hit a very neat compromise. They cut down the weight of the external skeleton to a minimum and, while they lose its protection, they still retain the great advantage of the additional strength. The result is tremendous speed of movement. But the insect can attain no great size, because of a very primitive oxygen supply system—just a number of tubes or trachea going into the body from the outside air.

So nature discovered that if she wanted size—and apparently she too is imbued with this "bigger and better" idea—she had to have an internal skeleton and a device for guaranteeing an adequate supply of oxygen, such as in the case of the shark. As a matter of fact, the shark is one of our very oldest species.

But here, as elsewhere, the solution of one problem only led to another. All animal life up to this present had probably been in the water, but there was a lot of dry land and plenty of plant life on it—why not invade? Only how? Once again that miserable question of oxygen supply held up the whole course of evolution. So nature handed this problem of an air-breathing land animal over to her research staff. Many and interesting were the early models. We have fishes which will drown in water, such as the Siamese fighting fish—it breathes air. Other fishes can leave the water and climb trees by means of their stiff fins. They take a deep breath, so to speak, in the water, close up the gills and hold it for ten minutes while on the land. Then we have a lung fish which can breathe in air when its pool dries up in the summer, but which much prefers water. We even have certain land animals—some salamanders—without lungs. They just gulp air into the throat and from there the oxygen diffuses into the blood stream.

NATURE'S ultimate answer was, of course, the lung. Originally this was probably the air bladder with which many fishes are equipped and whose duty it is to regulate the creature's buoyancy in water. If he wishes to come up he inflates the bladder, and vice versa—just like an army blimp. Some type of primitive lung fishes got the knack of gulping air into this bladder from the atmosphere. Then the oxygen diffused through the thin walls into the blood

stream and we had our first air-breathing animal.

We have come a long way from this primitive apparatus, however. The efficiency of your lung depends on the area of contact over which blood and air can come close enough to insure diffusion. The greater the area the more oxygen can pass into the blood stream. It is self evident that you would greatly increase the internal surface area of a simple bladder—say, a football—if you jammed it full of wrinkled tissue paper. The more you crinkled the paper and the more you crowded it in, the more surface of contact there would be—always supposing that you have enough room left for very tiny blood vessels and air tubes to traverse the whole mass of paper. This was nature's trick to improve the lung. Whereas the outside surface of your lungs is 16 square feet, so expert was nature at this crinkling process that the actual internal surface of contact is about 170,000 square feet, or over 10,000 times as great. So well has nature supplied you, that large areas of your lungs are relatively inactive. You can, in case of accident or tuberculosis, get along very nicely on one lung, or even part of a lung—provided you don't want to play football and race the engine.

SO nature developed the lung and got an animal which could live on dry land. For the first hundred million years he put in the early part of his life in the water, as does the present-day frog. Then the race of true reptiles came along, laying their eggs on land, and so the true land-living species developed. But, before developing these land animals, nature found herself up against another engineering problem—that of locomotion. How were these animals to move? Evolved, as they were, from fishes, nature did not have much to go on, for a fish is pretty helpless on dry land.

But never be it said that nature sidestepped a problem. She took the four main fins of the fish, two in front, two behind, and resolutely set out to develop legs. This idea seems very simple to us today, but the nearest approach nature had arrived at which could be adapted to land use was the single large foot, best seen in the case of the snail. This guarantees progress, but not much progress.

In fact, now that nature had produced a land animal, capable of large size and fast movement, she did exactly what the human being always does in the enthusiasm of youthful ignorance: she overdeveloped and overproduced. Dinosaurs—reptiles—came from the factory weighing up to 40 tons (your largest elephant weighs only ten tons), some of the carnivorous varieties being the fiercest beasts of prey the world has ever seen. The reptiles invaded the sea and produced literal sea serpents. They even sprouted wings, a-là-bat, and gave us the largest, fastest, and fiercest natural inhabitants of the air yet to be seen.

In fact, the reptiles ran the world. For from two to three hundred million years this world wasn't safe for even another reptile unless he could move very fast or was so huge and well protected that even these big bullies didn't dare attack him. Then, just when their rule seemed absolutely undisputed, nature wiped out the whole lot and turned to another model.

For some reason or other, nature had also manufactured these reptiles with a minimum of brains. Even the largest of them had a brain no bigger than your fist. They must have been extremely stupid despite their size and fierceness. Nature has since been producing models with more and more brains.

But the real weakness of these reptiles which probably led to extinction was the fact of their being cold-blooded animals. This carbon-burning engine which we call our body is exactly like your auto in many respects: it won't go if it's too cold and it stops if it heats up beyond a certain point. The cold-blooded animal is at the mercy of the temperature. As the thermometer approaches freezing he becomes sluggish, and at freezing weather the machine simply stops. The same applies when the temperature goes too high.

So nature evolved another model, the so-called mammal. She gave him a coat of fur to keep out the cold—or heat—then arranged an internal combustion system which works *always* so that the engine is continually warmed up. Not only that, but, in every species of mammals, she established an automatic thermostat. The human engine works best at 98.6 degrees. Any variation by as much as one half of one degree is a signal of engine trouble and for the services of a mechanic—no disrespect intended to the doctor. Just to make a good job of it, nature established the same mechanism in the newly evolving race of birds. Then she stood by to watch results.

The new machine proved its superiority in decisive fashion. Very soon the mammals and birds ruled the roost just as ruthlessly as had the reptiles. Then nature repeated her old mistake—bigger and better, but bigger at any cost. She developed mammals, such as the long extinct "thunder beast," Baluchitherium, of Asia, far larger than the largest elephant. And once again she wiped out the lot.

The trouble with these huge brutes was one of food supply. Every so often climatic changes occur which cause huge areas of the earth to become semi-desert in nature. If we had a severe drought in the western plains for five years, a mouse or a rabbit might survive; for after all, he only needs a leaf or two and somewhere or other that scant food supply will exist; the rabbits also might die by the millions but enough of them would survive to perpetuate the species, once the hard times had passed; but an elephant needs a bale of hay per meal, and that is something totally different. When drought conditions arrive, the big animals suffer most. And, if the climate changes, as it has in the glacial epochs when huge areas of the world were covered by ice, all animals are liable to extinction that cannot adapt themselves to a cold climate or to a hot climate, when the ice fields retreat.

So nature produced her latest model, man. She had learned that even her highly elaborate heat-conditioned mammal had its weaknesses, but she had also found that one of its most advertised features, namely, its brain, seemed really to be of survival value. In modern man she staked nearly everything on brains; for, as a machine, he is a joke. His naked skin gives absolutely no protection against the weather. He can't run rapidly; a tiger can catch him in a twinkle. And by himself he can't fight; any carnivorous beast his own weight can serve him up as breakfast to the cubs.

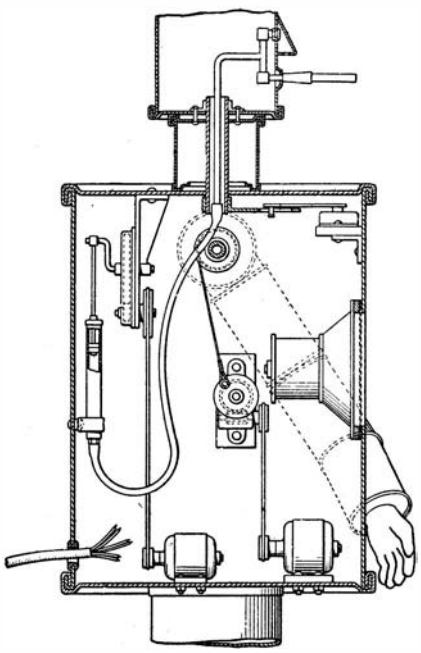
Though early man was much tougher than modern man, his best hope was his wits. Cornered, he seized a stick, and found his first club. One day he threw the stick and invented the spear. When the glaciers crept down he wrapped himself in a buffalo skin and discovered clothes. Somewhere he stumbled across fire. With skins, fire, and some sort of shelter he could let the blizzards blizz—if he didn't starve to death. But he didn't. He got the run of the seasons and learned to store food when the hunting was good against the lean winter period.

THIS last child of nature became literally a brain child. It has long been a commonplace of parental experience that bright children may need a little discipline, and it seems to many of us that nature is now reaching for the slipper. Her grievances are many but may be summed up in one major charge: man is using his brains to eliminate the fit and to perpetuate the unfit. To qualify as cannon fodder in this 20th Century you must be a physically perfect specimen; while the others live on. Also, we have learned tricks which give us our present differential birth rate, a system which restricts birth in the upper classes, and this may easily yield us a "moronocracy."

Any attempt to peer into the next million years merely impresses us with our own ignorance. We can say only that nature, after spending vast periods of time in developing a perfect machine—witness the cat—seems to have made a departure in the case of man. He is a mechanical misfit.

Automaton Salesmen

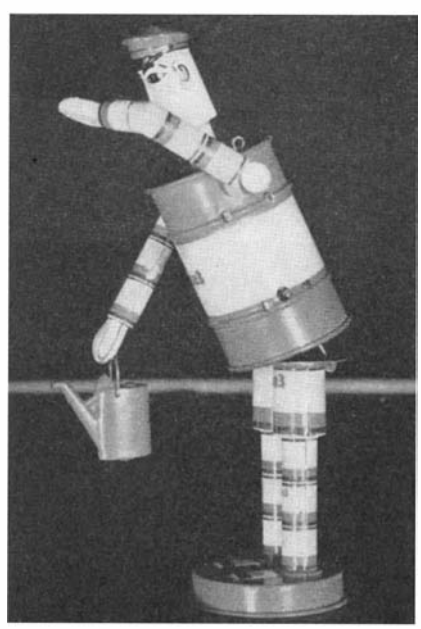
AUTOMATONS have been constructed by many engineers, in bodies that mimic those of human beings, but these have usually been for exhibition purposes and have been complex mechanisms of wires, photo-electric cells, and other special devices such as numerous push buttons, switches, and relays. Decidedly, they have not been of the type that an advertising department would purchase in quantities for merchandising demonstrations. Automatons to promote sales are, however, now available from a recently formed corporation. They are covered by patents.

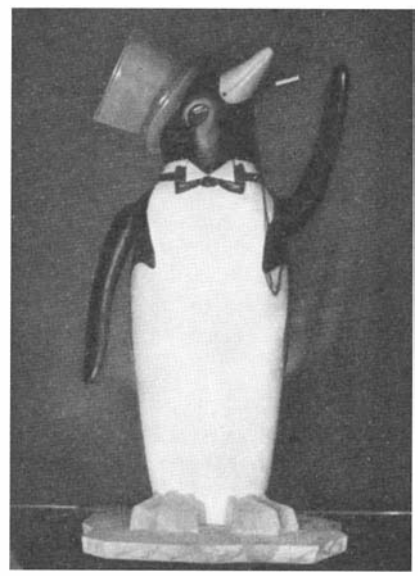


Mechanism of one of the earlier mechanical men, the basic features being typical of many of the designs

Mechanical Man, Inc., will make a figure to advertise any product by attracting the fascinated interest of the multitudes and thereby impressing upon them the particular trade name. More important, the figure may be made, outwardly, the personification of any trademarked figure or advertising design. Depending upon the product advertised, the automaton may be so constructed that it will make all kinds of body movements, smoke a cigarette, aim and fire a simulated gun, speak, or a combination of these and other life-like actions.

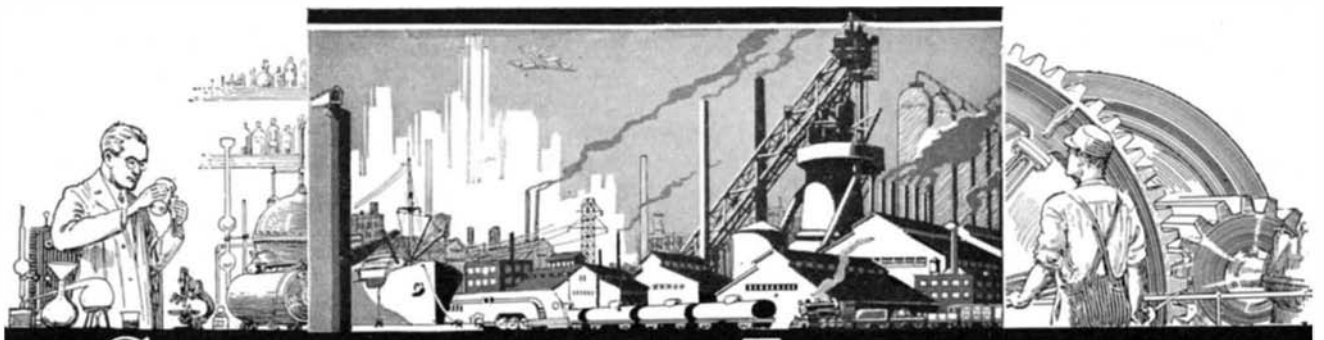
The ingenuity and versatility displayed in the design of the mechanism for these attention-compelling "salesmen" is their chief point of interest for the technical man. Their simplicity is, furthermore, most surprising. In all cases—whether the figure be small or large—all the action is powered by a fractional horsepower electric motor. Reciprocating movement of parts of the body is accomplished by rod linkages between disks driven by worm gears or pulleys. Adaptations of this simple principle give the designers an endless variety of possible combinations. A simple pump with a crank-operated piston supplies the suction, through a small tube, for puffing a cigarette.





The penguin (top) puffs contentedly on a lighted cigarette, winks, and moves flippers and head. The girl drum major spins her batons and executes graceful movements

Top of column: **Three small manikins which have been used to advantage in showing styles.** ***Above:*** **A bowing figure made of oil tins and an oil drum, used to greet patrons of garages and service stations.** ***At left:*** **One of the cleverest figures so far made. The four-foot hunter holds his gun at rest, his head up and forward. Then, as the pheasant rises, he turns and tilts his head forward, aims and "fires" the gun, and a red light flashes**



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

Anthracite Ash Improves Soil

PENNSYLVANIA anthracite ash has long been used to improve soils, but exact scientific data on such utilization were made available for the first time only recently. Compiling results of experiments conducted at the Mellon Institute of Industrial Research by the Multiple Industrial Fellowship in Anthracite, a booklet just published by Anthracite Industries, Inc., shows that Pennsylvania anthracite ash has at least five advantages for gardening use in improving heavy soils alone, namely; improved texture and workability of soil; better moisture absorption; reduction of erosion; improved drainage and aeration; and increased resistance to drought conditions.

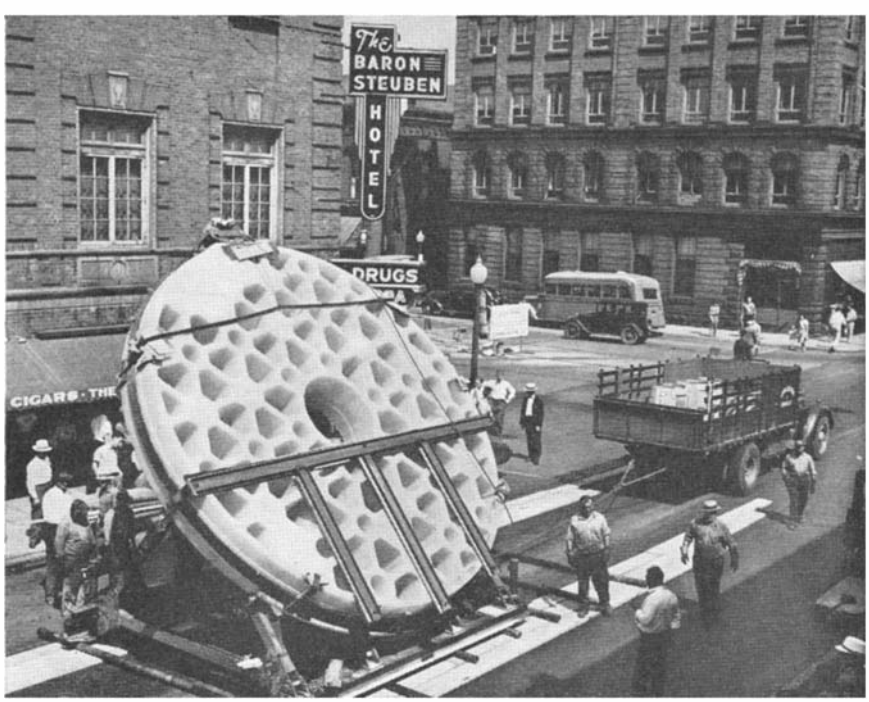
"Since anthracite ashes are of a mineral nature," the booklet points out, "their beneficial effect is permanent. In this respect they are superior to humus or other organic materials which tend to disappear from the soil in several years' time. A still further advantage is that humus and soil-conditioning materials are expensive, while Pennsylvania anthracite ashes are readily available in the anthracite heated home at no cost."

Suggestions for the improvement of lawn or garden soils are given, both as to amounts and methods of application of the ash, with outlines of procedure for the more scientifically minded or professional gardener for conducting his own experiments. Descriptions of additional uses are also given, including utilization as a summer mulch, for underdrainage, for making compost, for soilless culture, even for growing rhubarb in the basement during the winter months.

Telescope Museum

WHEN the Corning Glass Works cast the first of the 200-inch blanks for the gigantic telescope on Mount Palomar, California, some of the cores with which the under side was to be honeycombed floated out of place and made it necessary for a new blank to be cast. Because this great disk was the first such enormous casting in glass in the world, a stream of visitors was continually passing through the plant to see it, and it was finally decided to install this blank in a museum of its own in the city of Corning. Accordingly, a structure resembling a miniature observatory has been built in the Corning City Square, and by this time the blank will have been installed as a permanent exhibit.

So gigantic is this "sky eye"—17 feet in diameter and 20 tons in weight—that it was found necessary to build a special carriage for transporting it. An accompanying illustration shows the disk being transported through the city of Corning to its permanent museum. In this picture is clearly shown the imperfect honeycomb of its base.



Moving the giant telescope mirror blank to its museum

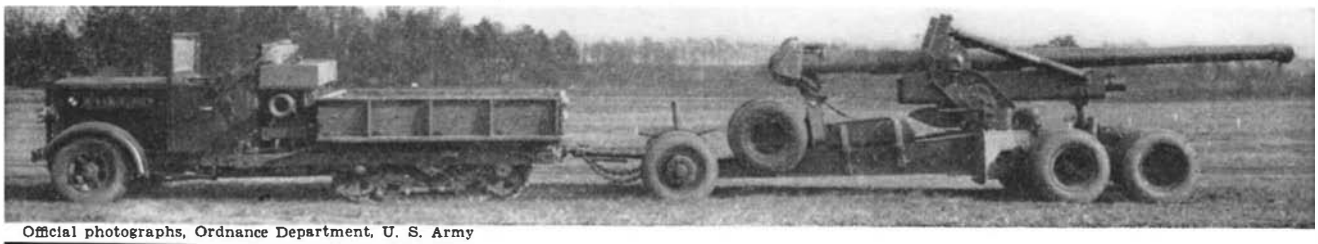
Water Soluble Resin

A SYNTHETIC resin which is insoluble in organic solvents but soluble in water, acids, alkalies, and salt solutions has recently been announced. It is film-forming when deposited from aqueous or water-solvent solution. The resin, Rhotex A-20, is recommended by the manufacturers as a water soluble thickener; a solvent resistant coating; a sizing, emulsifying, and dispersing agent; or a clear, colorless film base.

Cancer May Be Caused by Viruses

CANCER, at least of certain types, is caused by filterable viruses, and thereby joins a numerous and varied group of human ills including smallpox, influenza, and infantile paralysis. Such is the conclusion toward which points the evidence presented by Drs. James B. Murphy and Albert Claude of the Rockefeller Institute for Medical Research, by Drs. Jacob Furth and Elvin A. Kabat of the Cornell University Medical College, and by Dr. F. Duran-Reynals of Yale University.

Fluids from malignant transplantable tumors of chickens were whirled in the ultracentrifuge, passed through fine-pored filters, and otherwise treated after the manner of virus-containing fluids in known animal and plant diseases. Materials obtained from these cancer-fluid filtrates, injected into the tissues of healthy chickens, produced typical cancerous growths.



Official photographs, Ordnance Department, U. S. Army

The 155mm field gun being towed by a track-laying truck

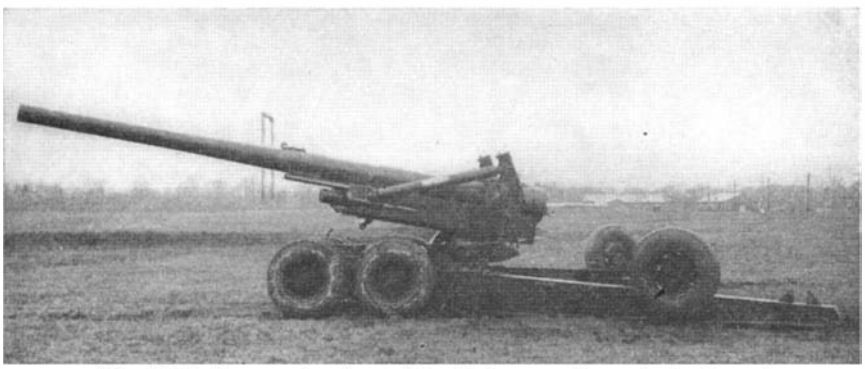
In the researches reported by Dr. Duran-Reynals, chicks responded to doses of a tumor virus by developing fatal hemorrhages and degeneration of tissues, without the development of tumors. However, extracts obtained from such chicks produced the characteristic growths when injected into healthy adult fowls.—*Science Service.*

Longest-Range Field Gun

THE United States now has a field gun which has fired a projectile farther than any other standard field gun has ever been fired. Of 155mm caliber, it sends a projectile a distance of 25,000 yards or, roughly, 14 miles, and blasts a hole in ordinary ground 16 feet deep. It has been named the 155mm gun, MI.

Development of this gun grew out of a need seen in the World War, particularly at about the time of the first battle of the Marne. The noted French artilleryman, General Herr, wrote of the difficulties the French had in retreating under the heavy fire of German guns with no guns which could answer in kind. They needed artillery of very long range which could remain far behind the lines and yet paralyze the enemy and harm their morale. This would be done by insistent shelling of the main roads of enemy approach, important stations, ammunition depots, and centers of distribution, and by making their headquarters untenable and demolishing points of observation. Further, these guns were found necessary for bombarding the enemy's roads of retreat, their reserve stations, and supply dumps of all kinds. This kind of fire was called interdiction fire.

Hence, there was a demand by the Caliber Board of the United States Army for a gun of about caliber 155mm, with a vertical arc of fire from 0 degrees to plus 65 degrees; a horizontal arc of fire of 360 degrees; a projectile weighing not over 100 pounds; a maximum speed of 12 miles per hour; and



The field piece can be elevated to 65 degrees above the horizontal

a width and maneuverability which would permit its use on highways on which there is heavy traffic.

The 155mm gun has met most of these requirements. Its weight exceeds the weight limit by 28 percent, as it is slightly over 15 tons. Its over-all width is about 99 inches which is somewhat too wide for rapid movement in two-way traffic. On anything but the most modern concrete roads, its weight and width provide a severe handicap. Despite these factors, it is an extremely efficient weapon. In action, it will not be called upon to make long forced marches but will be used as our principal instrument for reaching the long-range targets mentioned above. It will, of course, be assisted by more powerful guns and howitzers on railway mounts.

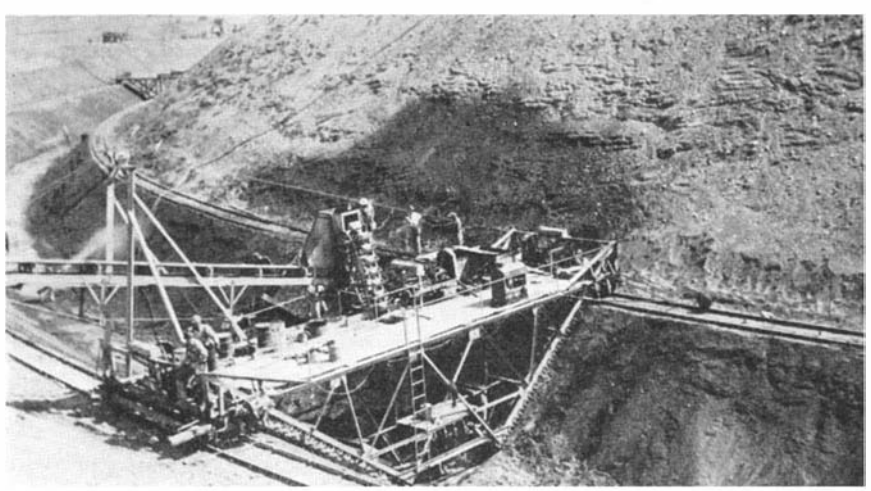
This new gun is mounted on a six wheel bogie with rubber tires and in the firing position will be lowered to a firm position made by spreading the outrigger spades.

Jumbo Canal-Wall Trimmer

THE fourth and last section of the great "Yakima Project" is now far advanced—a system of canals, tunnels, flumes, and siphons which will eventually irrigate 72,000 acres of farm land in central Washington. Many miles of this project will be canals of an open "V" shape with concreted walls and beds. To expedite the concreting job, the sides and bed were trimmed by a unique traveling machine developed in the shops of the H. J. Adler Construction Company.

This new trimmer rides on a single rail on each canal bank. It is powered by three Ford motors—one on each bank, and the third for the belt conveyor which is loaded by a centrally located bucket elevator. The entire trimmer advances at the rate of a foot and a half a minute.

The sides of the "V" are two 17-foot rollers, studded with hundreds of small projecting teeth or pins. As these rollers, which are made of 12-inch heavy-duty pipe, are moved along the slopes of the canal, the spirally-set teeth engage every inch of the surface and shear it smoothly. The shearing is so complete that no overdigging or back-filling are required, and fine grading can be done at a fraction of the usual cost.



Traveling canal-wall trimmer that rides on rails

EXPLOSIVES

IN the past 12 years, American and Canadian railroads have transported millions of tons of high explosives without death or injury to anyone.

Waste

AT one of the symposia of the recent meeting of the American Chemical Society were discussed some of the more important of the large number of instances where industrial or trade wastes have been converted through research into raw materials for the manufacture of commercial products. It was stressed that differentiation must be made between by-products in the usual sense and materials which are true wastes —not only useless but often involving expense for their satisfactory disposition.

Under this latter classification may be included the manufacture of sulfuric acid and recovery of elemental sulfur from smelter gases, the production of sulfuric

acid from the hydrogen sulfide in petroleum still gases, and the recovery of by-product sulfur from the hydrogen sulfide in illuminating gas. Sulfite waste liquor has become the source of vanillin and a number of other products.

Waste casein finds its way into resins and adhesives; the fermentation residues in the alcohol industry have been converted into cattle foods and the carbon dioxide into dry ice. Potash is recovered from the dusts of the cement industry, and building blocks have been made from the fly ash.

In a sense, the long list of solvents now recovered from gases derived from petroleum represents success in the use of otherwise waste materials. The same may be said of cements made from blast furnace slag, and synthetic methanol utilizes carbon monoxide present as an interfering substance in gases used in the fixation of nitrogen. Furfural from oat hulls, and Celotex from bagasse are other examples of this type of material.

LINENS

THE Pullman Company is sometimes called the world's greatest housekeeper. In one year it purchased 220,528 sheets, 157,780 pillow cases, 20,253 tidies, 455,829 hand towels, 24,318 headrest covers, 13,692 napkins, and 3260 table cloths.

Chlorinated Rubber

IF further proof is needed that American engineers and chemists are equal to or better than European technicians, it may be found in a recent issue of *Chemical & Metallurgical Engineering*. James A Lee, writing in that magazine, states that in the few years since securing the rights to produce chlorinated rubber in this country, Hercules Powder Company chemists and engineers have improved the original characteristics and have been exporting chlorinated rubber to the markets of Europe.

Vinyon, Important Synthetic Fiber

ANOTHER synthetic resin fiber, that can be turned into lustrous silk-rivaling hosiery, has just been announced. Known as polyvinyl acetal resin, the new fibers are further cause for headaches among the Japanese for they are synthetic, made-in-America rivals for Japan's natural silk. Silk is the largest single export of Nippon to Uncle Sam.

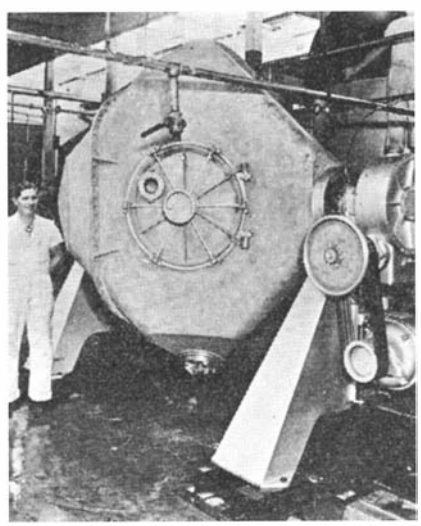
A research team of Carbide and Carbon Chemicals Corporation, including Harold F. Robertson, Edward W. Rugeley, Theophilus A. Field, Jr., John F. Conlon, C. O. Young, and S. D. Douglas, has been busily piling up patent after patent on this achievement.

Polyvinyl acetal resin can be produced in fibers as fine as natural silk, virtually as strong, more elastic, waterproof, and fireproof. The basic materials of the newest fibers are salt, coal, lime, and air. Out of these cheap and plentiful raw materials are made high molecular weight (7000 to 13,000) water-clear resins. The actual production consists of polymerizing vinyl halides with vinyl esters.

Among the suggested uses of the new fibers, besides the hosiery field, are: waterproof clothing, bathing suits, fireproof awnings which are silk-like in appearance, fishing lines, fishing nets and seines, acid and alkali-resistant clothing, electrical insulation, and curtains for shower baths. The new fiber material, to be known as Vinyon, is not yet in commercial production for hosiery. In its properties, it is comparable with nylon, developed by du Pont chemists, although the latter is made by a different chemical method.—*Science Service.*

Biggest Butter Maker

THE largest churn in the country has just been built by the Jensen Creamery Machinery Company, Oakland, California, and installed in the Challenge Cream and Butter Association plant in that city. It is constructed from two sand-cast aluminum shells which, together, weigh 1500 pounds. In tests, this unit has churned 660 gallons of cream into 2580 pounds of butter



Batches of 2580 pounds of butter are made in this aluminum churn

in 30 to 45 minutes. Because of the cubical design, the churn is reported to be capable of churning butter in 50 percent less time than the conventional roll type units.

The huge aluminum castings which make up the body of this new dairy machine were cast at the Los Angeles foundry of the Aluminum Company of America, and are among the largest aluminum castings ever made. The patterns were so large that special doors had to be built in order to move them out of the pattern shop into the foundry for casting. Aluminum was used in the construction of this churn in order to obtain the advantages of the metal's lightness and non-contaminating properties.

New Refractometer

A SIMPLE instrument for measuring the refractive index of glass has been devised by Frank Benford of the General Electric Research Laboratory. Though smaller and much less costly than previous instruments, the new refractometer is accurate to two decimal places. The principal parts of the device are a telescope, mounted like a microscope, and a polished metal prism. One surface of the latter is vertical

Refractometer and its telescope

and another is at an angle of 45 degrees from the axis of the telescope.

As the angle of tilt is fixed at 45 degrees by the prism, only the thickness of the glass and the amount of displacement of an object viewed through it need to be measured. The thickness is measured by placing the sample against the vertical face and taking comparator readings.

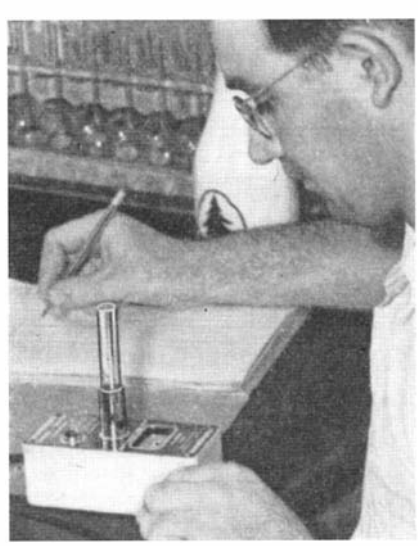
Attached to the tilted surface of the prism is a piece of drawing paper on which a large dot has been made with black ink. Displacement is measured by adjusting the base until the cross-hair of the telescope is tangent to the dot, as viewed directly, and then through the test glass. The difference is the optical displacement. With this datum, the index of refraction can be determined by slide rule and reference to tables.

For the study of thick glass, the use of a sodium lamp as an illuminant has been found advantageous.

Phosphatase Test Made Electrically

ANOTHER step in making milk safe for public consumption is taken by the Luximeter, a new instrument developed by the General Electric Company to check the degree of pasteurization of milk by the phosphatase test.

A chemical test for determining the de-



Milk undergoing phosphatase test

A truck is used for transporting the radio-controlled target plane to and from the anti-aircraft range

gree of pasteurization has been used for the last few years with great success in the Scandinavian countries, and the New York State Department of Public Health has been among the first in this country to experiment with this method of making the phosphatase test. General Electric has been working in close collaboration with the New York State Department of Public Health for the last year and much valuable data and suggestions have resulted from the efforts of the Health Department.

The G-E Luximeter, while designed primarily for use in measuring the transmission of the blue solution obtained in the phosphatase test for milk, has many other possible applications. One use in particular to which it may be readily applied is that of making a turbidity test in water supplies. Satisfactory turbidity measurements have been made over the range of 100 to 3500 parts per million on the silica scale.

The new instrument consists of a light source, a light-sensitive cell, and an indicating instrument, all in one compact unit. The light source is regulated by a rheostat and is directed through a glass tube containing the solution to be measured. The light so transmitted falls on the sensitive surface of the cell where the values are read directly in percentages on a micro-ammeter.

Requiring only a six-volt, half-ampere power supply, the Luximeter may be attached to a storage or dry battery, or voltage regulating transformer. The new instrument weighs only two pounds. It may be carried about by milk inspectors on their tours of dairies or used by large dairy owners in testing their pasteurization.

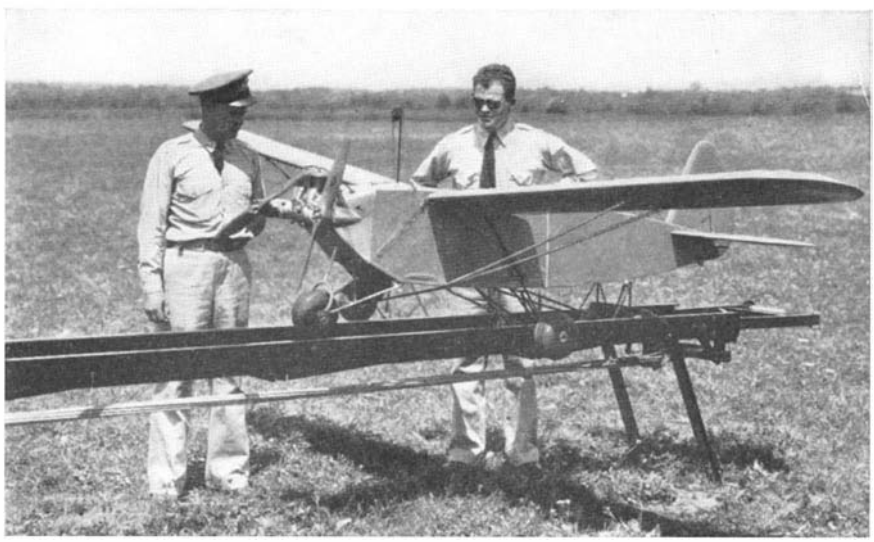
PILOTS

BY the end of 1941, Robert H. Hinckley, Chairman of the Civil Aeronautics Authority, predicts that the United States will have a total of 70,000 licensed pilots.

Radio Controlled Target Airplane

FOR training infantry and field and coast artillery in anti-aircraft gunnery, targets are frequently towed behind an airplane which flies at a relatively low height. These targets are of the sleeve type, resembling the wind socks seen at most airports.

Towing sleeve type targets has many disadvantages. The targets cannot be maneuvered sufficiently, and they do not simulate the outline of an airplane. The pilot of the towing airplane may be struck by a stray bullet—although such a mishap has not occurred to date. Further, the rifle or machine gun personnel on the ground have no way of telling whether their fire would have reached a vital spot of the airplane.



Target plane ready for launching from its catapult. A two-cylinder engine drives the twin propellers

All these disadvantages will be eliminated, and many new advantages will be secured, by the use of a small radio-controlled airplane which is in process of test by engineers of the Army Air Corps at Wright Field, Dayton, with Captain George V. Holloman directing the experiments.

The little airplane is only about one third the size of a normal combat airplane and has a 12-foot wing spread. It is flown at reduced speeds and has a service ceiling of about 5000 feet. The target airplane is maneuvered solely by a radio transmitter controlled by an officer standing in a safe position on the ground. By means of a small hand-held instrument, similar to the dial of a telephone, the ground officer can cause the target plane to turn, bank, dive, or zoom, giving realistic representation of a maneuvering aircraft.

When all is in readiness for the take-off, the small air-cooled engine of the target plane is started and adjusted to the required revolutions per minute. A catapult shoots the airplane into the air, and flight is maintained by two small propellers driven by the single engine. These propellers rotate in opposite directions so that torque and slipstream effects are eliminated. When the aerial target has completed its mission and given the ground personnel sufficient practice for the day, the operator directs the little craft to a landing area. He then presses a button; immediately the motor stops and a parachute springs from the airplane. The target floats gently to the ground and is soon ready for another tour of duty.

One of the advantages realized, in addition to the disadvantages eliminated, is the small cost of construction and the ease of maintenance and repair. Even if struck in a vital spot, the target airplane can be readily put back into commission. Again, the target airplane can be operated in a minimum of space, at a place convenient for any branch of the service. Previously, anti-aircraft practice could be undertaken only in the vicinity of a large airdrome.—*A. K.*

Four Bladed Propeller

THERE seems to be no difficulty in increasing airplane engine power almost indefinitely. At least the power of aircraft

Four blades for powerful engines

engines seems to go up a hundred horsepower or even more per annum, and such progress has been continuous for at least ten years. The increased engine powers introduce a serious difficulty, however, in the matter of the propeller.

To absorb the power of, say, a 2000 horsepower engine, in a relatively small airplane, the diameter of the propeller becomes inordinately large. This means a long, heavy, and clumsy landing gear, which is a serious disadvantage. Also, the speed of the ends of the propeller blades becomes so high as to approach the speed of sound—with consequent loss of thrust and efficiency.

As a result of these facts, Curtiss propeller engineers have now replaced the three-bladed airscrew by a four-bladed one. Tests have indicated that this new trend in propeller design is quite satisfactory, though even with the four blades there is some sacrifice in efficiency compared with airscrews carrying less power for the same diameter.

The airplane shown in the photograph is the Curtiss P-36A pursuit, which is highly popular with Army Air Corps pilots. The blades of the airscrew are of thin aluminum, and are electrically controlled. The pilot can select the pitch, and then the airscrew can be used as a constant speed propeller. When the engine stops it is possible to feather the blades fully; that is, to set them completely on edge to the airstream. This combination of characteristics is very useful for reasons which we have discussed in past issues.

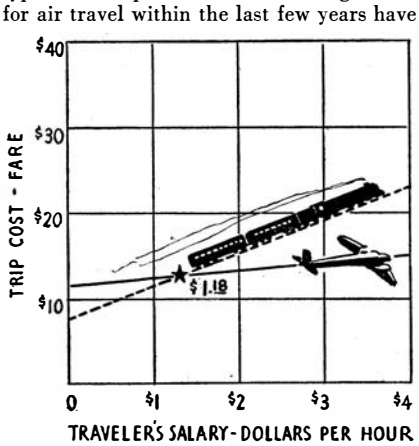
At high altitude the absorption of power of a supercharged engine is still more difficult. Some engineers even believe that in addition to pitch control, and four blades, airscrews may need a change-speed gear or even extensible diameter. In fact, one company is already working on an extensible diameter propeller.—*A. K.*

Economy of Air Travel

THE following figures have been submitted to us by an airline company, whose name we do not mention for obvious reasons. Even though they come from an interested source, the figures and arguments are so logical and so trustworthy as to deserve full credence.

It is true that air travel fares were once considerably higher than those for other types of transportation. And although rates for air travel within the last few years have been substantially reduced, air travel is still in many cases a higher *fare* form of transportation. Yet the differential between air and railway travel is not great, and practically disappears when other expenses are taken into consideration. Thus a round trip by air from Atlanta to New York costs only $81.84 and takes only 12 hours. Meals are free and there is no tipping. This same round-trip by rail costs $58.75 for fare alone, plus an average expense of $11 for meals and tips en route. And the rail trip takes 45 hours.

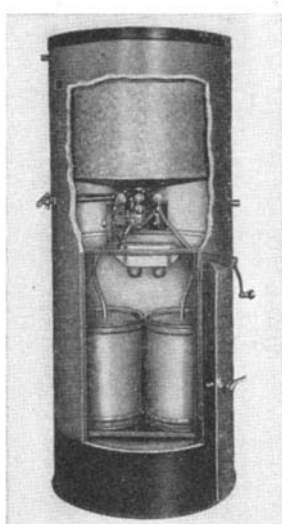
When salaries of business executives are taken into account on a conservative basis, air travel actually becomes cheaper. For a trip of 200 miles, when salaries per hour and time saved are taken into account, the business man saves money when his salary reaches the figure of only $1.18 per hour.—*A. K.*



As the air traveler's salary goes up, the economy of aerial transportation becomes more apparent

Oil Conditioner

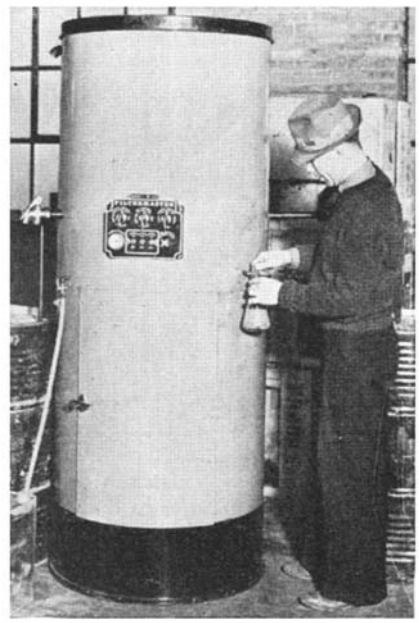
LUBRICATING oil in motor cars accumulates impurities such as water, acid, dust, carbon, and metal particles. The heat of the engine plus the oxygen in the air form engine-clogging products generally referred to as "varnish." These resins and tars affect the engine's performance, and in some cases may "freeze" new motors. Frequent cleaning of the oil by passing it through a new device called the Filtermaster will stop the trouble caused by such impurities.



Thoroughly clean oil, free from all dirt, impurities, and acid, is delivered to the motorist from this oil conditioner. Dirty oil from the crankcase is pumped into the device, where it filters through a cartridge and is cleaned

The Filtermaster, which is made by Clean Oils Corporation, is a simple tank-like affair into which the oil is pumped from a motor-car engine. The equipment does not do an actual job of reclaiming in the ordinary sense, but does clean and wash the oil of all impurities. It uses a special, replaceable filter cartridge which absorbs the impurities, and a neutralizing alkali to counteract the acidity of the oil as it passes through.

The machine ordinarily runs an average of 25 gallons at a time, so that the car owner does not actually have returned to him the identical oil which was pumped from his car. The theory of operation is that a garage owner would either simply swap clean oil for old or make a standing contract with steady customers to keep clean oil in their motors for a specified period at a specified price.



The oil conditioner

Paper Coating From Corn

AVAILABLE as a by-product of corn processing, Zein, an industrial protein, gives promise of outstanding usefulness in the paper coating field. As a decorative coating for magazine covers, labels, and similar uses, it gives a pleasing surface without the high gloss of some other coating materials. It can also be formulated with a high gloss and is particularly notable for resistance to scuffing.

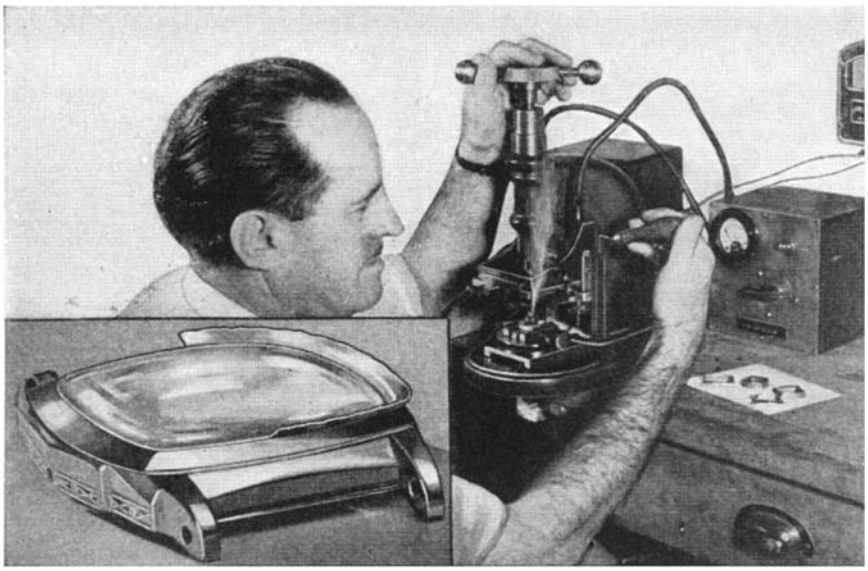
Commercially produced as a fine powder of slightly yellowish color, Zein contains not over 2 percent non-protein solids. The potential yield is approximately one pound per bushel of corn.

HEAVY

A CUBIC inch of matter from a recently discovered "white dwarf" star, named Wolf 457, would weigh 9000 tons. This is just under the weight of one of our latest Navy cruisers. A particle of this could not be supported by any known matter on earth, for it would "sink" through even our strongest metal.

Infra-Red Rays Speed Seed Germination

INFRA-RED rays have been successfully used to increase seed germination by as much as 50 percent. This is the report that comes from the Leray Corporation, makers of the infra-red lamp which was described in our January, 1939, issue, based upon tests made some time ago by the Sanders-Durling Entomological Service of New



Melting an unbreakable watch crystal into place. Inset shows a crystal, mounted in position, from which part of the surplus plastic material has been trimmed

York. These tests indicated a very noticeable stimulation as well as an increase in germination.

In these tests, seeds were subjected to the infra-red rays from the Leray lamp. This lamp is attached to any 110-volt electrical circuit, and is moved slowly and carefully at a set distance above the surface of the seeds. Ten seconds has been found to be the most effective time for keeping the lamp in any one position.

The success of these tests indicate possibilities for improving gardens by insuring better germination.

GEMS

THE Smithsonian has just had added to its collection the largest topaz crystal ever known. This crystal, totaling 350,000 carats, compared with the ordinary gem topaz of four or five carats, was found in Minas Geraes Province of Brazil.

DIKETENE AND THIODIGLYCOL

DIKETENE, to which the structure of vinyl beta acetoloctone has been assigned, was described at a recent meeting of the American Chemical Society. It is a new industrial chemical which is now available in commercial quantities. Its industrial importance lies in the valuable products which may be synthesized from it because of its exceptional reactivity.

Of current interest is thiodiglycol, also discussed at the meeting. This chemical is useful chiefly as a starting material for the manufacture of mustard gas. A new method of synthesis from ethylene oxide and hydrogen sulfide was described, which is much less expensive than former methods.

UNBREAKABLE WATCH CRYSTALS MELTED INTO PLACE

UNBREAKABLE watch crystals, in use for many years, have had a disadvantage in their inability to exclude dust from the face of the watch since their flexibility causes them to bulge and leave open cracks at the edges. A new method of mounting such crystals on watches, developed by Dutcher Bros., Inc., gives a perfect seal at the edges.

This corporation puts the watch into a machine especially devised for the purpose, places an oversized crystal on the watch, and then melts it into place under slight pressure at a temperature of 225 degrees, Fahrenheit. No cement is used, but the melting at the periphery of the crystal seals it to the rough edges of the bezel. The surplus plastic material from the edge of the crystal is then trimmed off.

FLUID ANALYSIS BY LIGHT

ANALYSIS of colorless fluids and some colored fluids which appear colorless is a simple and quick process with the new Coleman Regional Spectrophotometer, developed by Coleman Electric Company, Inc., which has a two-fold value—first for generating a true spectral transmission curve over a range from the near ultra-violet far into the infra red, and second for determining rapidly the concentration of colored ingredients of solutions. It is particularly valuable in industrial control or inspection laboratories, being used, for example, to determine minute quantities of lead, copper, and other foreign substances which may be in canned foods and beverages.

The Model 10 R-S-photometer utilizes the proved basic principles of spectrophotometry. A control with a linear scale, calibrated from 350 to 1000 millimicrons, from the near ultra-violet far into infra-red, permits selection of any 30-millimicron band to fall on a slit opening into the test chamber. Light from this selected region of the spectrum then passes through the sample liquid.

More or less absorption occurs, depending on the nature of the fluid being examined. The unabsorbed light is collected in a photocell and quantitatively determined to better than 0.5 percent. By substituting a standard solution in the same light path, the ratio of the light intensity at the selected wave band is indicated directly as percent transmittance by any Model 3 Coleman Electrometer. These results are independent of line voltage fluctuations and do not depend on colored filters. These data are precise expressions of fundamental units of color chemistry—percent of transmittance at known wavelengths of visible or invisible light.

VARIABLE POWER TELESCOPES

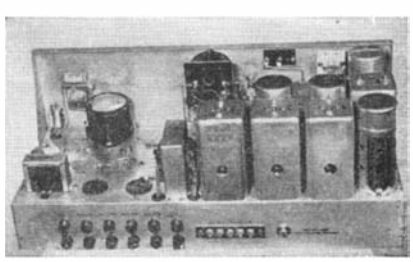
SHARP images in steps of five powers, over a range of five to 50 powers, are claimed for new telescopes recently announced by Wollensak Optical Company. No one telescope gives this full range though there are as many as six ranges in some of the new telescopes. Under the trade name of Vari-Power, these telescopes have knurled focusing ring; non-loosening, non-wobble joints that are dust-proof and moisture-proof; and chrome-plated rust-proof tubes.

PENCILS

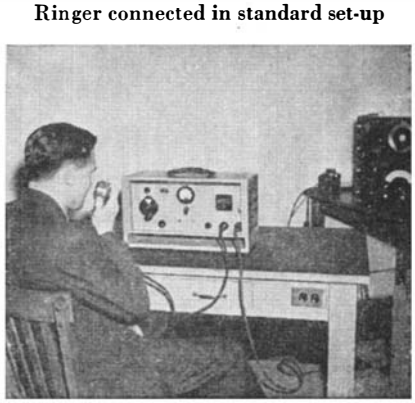
NEARLY four million lead pencils and 2600 gallons of ink per year are used by the employees of the steel industry.

BELL-RINGING RADIO DEVICE

A NEW bell-ringing device, which permits emergency radio calls to be put through as easily as telephone calls, has been developed in the Forest Service Radio Laboratory at Portland, Oregon. This standby unit has been developed for the new Type T ultra-high-frequency radio set, which is a semi-portable outfit operating on 30,000 to 40,000 kilocycles. Any Forest Service ultra-high-frequency radio set, however —even the lightest eight-pound portable—



Above: Interior of the bell-ringing device developed for Forest Service radio equipment. *Below:* Ringer connected in standard set-up



can call a lookout or other station equipped with this bell-ringing device.

Planned primarily for use at fire lookout towers, ranger and dispatcher stations, this device will eliminate the constant noise from loudspeakers when operators are "standing by"—a noise especially annoying during telephone conversations.

Lookouts and other forest officers will no longer need to stay close by their radio sets waiting for calls, as the device may be adjusted to carry signals to men working outside their stations. Lookout men can be aroused from sleep by the ringing bell if a night-look for fires in their territory is required. A series of code-rings is possible when several stations are included in any one Forest Service network.

Portable Metal Fire Escape

A NEW fire escape which combines the strength of a permanent fire escape with the portability and ease of handling of a rope ladder is shown in one of our illustrations. A product of Engineering

Development Company, this unit may be anchored on any window sill without difficulty, and then dropped to the ground as one would drop an ordinary rope ladder. In the 16-foot length for a two-story building, the ladder weighs 15 pounds, while in the three-story length—24 feet—the weight is 20 pounds. The load capacity is 1800 pounds, and each rung, which is built in the form of a stirrup, has a footing of 4 by 9½ inches.

First Year of the Civil Aeronautics Authority

IT was quite appropriate that at the completion of the first year's work of the Civil Aeronautics Authority, Chairman Robert H. Hinckley should make public a statement as to its own activities and those of civil aviation as a whole, which, from every point of view, have been highly satisfactory.

In June, 164,578 passengers were carried, or 64 percent more than in the corresponding month of 1938. During the first six months of 1939, 1627 airplanes were produced, while in the same period for 1938

only 850 civil aircraft were constructed.

Today 26,144 pilots hold certificates, or 6000 more than a year ago. There are 11,160 certificated airplanes or 1400 more than a year ago. Even without the C.A.A. pilot training there should be 36,000 certificated pilots by the end of 1940, and 43,000 by the end of 1941.

Federal airways have been increased to a total of 25,000 miles, with improvements in aids to navigation more than keeping pace.

The C.A.A. flight training program will give us 10,000 student pilots next year.

The Washington airport at Gravelly Point is beginning to take shape, with work proceeding rapidly under the supervision of the Corps of Engineers of the United States Army.

The existing system of scheduled airmail carriers is now legally a public utility. Certificates have been issued which make the existing airlines secure in their positions and free to plan for further progress.

The safety record of the airlines has been remarkably good. They flew 72,900,000 miles per pilot fatality; 51,700,000 passenger miles per passenger fatality; and 24,300,000 miles per fatal accident. These records are nearly three times better than the same records for the year 1938.

Technical developments have been equally satisfactory. Ultra-high frequency radio ranges operating at 63 and 125 megacycles at Indianapolis and Pittsburgh have been proved to be free of static whether from natural or artificial causes. This freedom from static, particularly in bad weather, is one of the most important elements in air transport radio communication and safety. Contracts have been let for three units of a new and approved type of ground direction finder. The blind landing system nearing completion at Indianapolis is one of the most comprehensive yet devised.

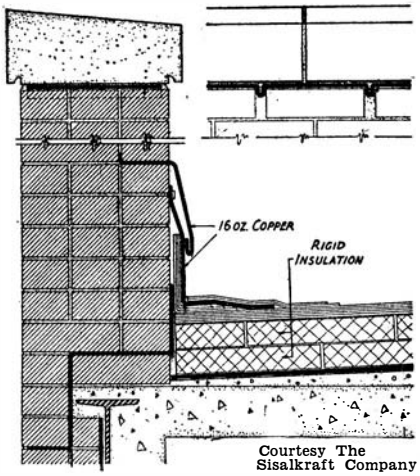
The Safety Board has developed its methods of accident investigation, with hearings conducted at or near the scene of the accident within a remarkably short time thereafter. The publication of reports after such investigations has given aircraft constructors and operators much valuable information.—*A. K.*

Cheaper Copper Protection on Fiber Base

COPPER has been valued as a protective metal in building construction for many centuries. However, its high cost militates against its use in many places where it would do a superior job of protecting against leakage or dampness. At least two companies—The Sisalkraft Company and the Angier Corporation—have provided an inexpensive product for use in all types of flashings, which combines the protective value of a very thin copper sheet with the strength and body of an adherent impregnated fiber.

Both of these companies use very thin sheets of pure copper completely free from pin holes, produced by electrical deposition of the copper on lead drums.

In the case of the Sisalkraft product, this thin sheet is bonded under heat and pressure to their own tough product called Sisalkraft. The resulting sheet, which may be made in different thicknesses for different installa-



Courtesy The Sisalkraft Company

How thin sheet copper, bonded to a fiber base, is used to waterproof a parapet and damp-proof the insulation under built-up roofs

tions, is flexible, will not kink or crack, can be cut to fit with ordinary shears, and is easily bent to place by hand.

The Angier Corporation's product, called Copperskin, is backed up with tough and durable paper to provide the advantages of regular 16-ounce copper at approximately one fifth the cost. The backing material is called Brownskin, is resilient, and can stretch or shrink with the expansion and contraction of the copper due to temperature changes.

Frozen Solar Energy

FLORIDA sunshine shed its glow at the New York World's Fair one day, playing a rôle in ceremonies at the Florida State Exhibit Building. Flown from Jacksonville in inert form, the sunshine had been absorbed by luminescent powder and "canned" by being frozen in liquid air.

The feat of rendering solar energy inert, then transporting it nearly 1000 miles and releasing it, is believed to have been accom-

Mr. Hibben measuring a quantity of powder such as was used for demonstrating "canned" sunlight

plished successfully for the first time. It was directed by Samuel G. Hibben, lighting engineer for the the Lamp Division of the Westinghouse Electric & Manufacturing Company.

In absorbing light energy, scientists believe, the luminescent powder actually undergoes a temporary change in physical structure. The theory is that the outermost orbits of electrons, which make up the molecules and atoms of the powder, are distorted or literally moved from one energy level to another when excited by impinging light, actually imprisoning some of the light.

Then, just as a piece of sponge rubber springs back to its original shape on being released from the hand, so do the electrons tend to return to their normal positions, and in so doing, give out the light energy they have imprisoned.

ELECTROMETRIC pH STANDARDS

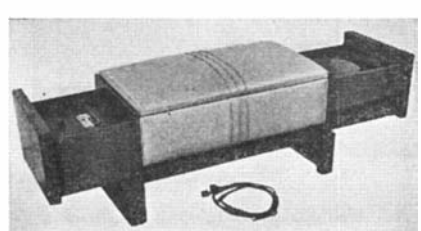
TIME-SAVING capsules of chemicals in powder form are now available for use as reference standards for checking electrometric pH apparatus. The "Hydrion" Buffer Standards, as they are called, when dissolved in the proper amount of distilled water, make solutions, the pH of which have been electrometrically checked by the manufacturer. Five different standards are offered, ranging from 3.0 to 9.2 in pH value.

STORYTONE

AN electrical musical instrument that captures all the richness of tone, volume, and color of the grand piano and is housed in a cabinet no larger than a spinet, has been developed by RCA engineers in collaboration with craftsmen of the Story & Clark Piano Company. The new instrument will be marketed through Story & Clark dealers under the name Storytone "Voiced by RCA Victor."

Providing the music of the piano, the radio, and the phonograph, the Storytone utilizes specially designed electrical amplifying and speaker equipment to reproduce the full range of tones with sparkling clarity and brilliance. The volume is easily controlled by a single knob located at the end of the keyboard panel. The range is so flexible that a single turn of the knob produces the softest whisper of a note or brings forth the full tonal blend of a powerful crescendo.

When the volume control is adjusted to conventional piano range, the Storytone rivals the largest concert grand piano, and when the amplifier is turned low or completely off, a pleasing harpsichord effect is produced. In addition to the customary "damper" and "soft" pedals, the instrument is equipped with a "swell" foot pedal with which organ effects may be produced through regulation of the amplifier volume.



Bench of the Storytone, opened

Used in conjunction with either a radio or phonograph, the Storytone reproduces radio programs or recorded music. A special piano bench has been designed which contains a radio and phonograph located separately in two sliding drawers placed directly beneath the seat. A simple plug-in connection permits easy operation of either instrument. The Storytone may also be played while the radio or phonograph are in operation.

Musical versatility

Unaffected by either temperature or humidity changes, the instrument's tone is developed electrically through a seven-tube amplifier of 20 watts output. Set in motion by the percussion of the striking hammers, the mechanical vibrations of the strings induce corresponding electrical vibrations in the coils of magnetic pickups. These electrical vibrations are then amplified by radio tubes and converted into audible musical tones by a powerful high-fidelity loudspeaker.

Junior Arc Welder

FOR garages, blacksmiths, construction engineers, machine shops, and others, a new 200 ampere arc-welding unit, either belted or direct-driven, has been developed by the Lincoln Electric Company. A compact unit, with its own control board, this welding unit weighs approximately 320 pounds.

Old Buildings Made Fire Resistant

FOUR out of every five deaths caused by tenement house fires—that annually take a toll of hundreds of lives in American cities—can be prevented.

A four-year campaign by the New York building department to make Old Law tenements more fire-safe, has succeeded in reducing the number of deaths resulting from general conflagration in them from 38 in 1934 to 7 in 1938.

The campaign, backed by State legislation, is an effort to make the average Old Law "tinder box" into a more fire resistive building by requiring that it be equipped with a fire-resistant cellar ceiling, fire-retarded stairwells, and modern stair-type fire escapes.

The total cost of all three improvements, according to general estimates, is about $50 a family—inexpensive and permanent life insurance for the families protected.

Fire-retarded stair halls, the basis of the new fire protection, is a comparatively new contribution to building safety. It is an attempt to make the ordinary wood stud and plaster stair-hall walls of the average

tenement house more fire-resistant so that they can confine the fire to its place of origin instead of serving as a giant flue for the flames from first floor to roof.

Various methods of fire-retarding are today approved by the New York Building Department. The simplest method, however, is one which requires no changing of existing construction. Widely used in New York City, it employs granulated mineral wool, a fireproof material with excellent heat-stopping properties that has been used for many years to insulate the roofs and side walls of building against heat and cold.

This same material is easily adapted to stair hall fire-retarding. Small holes are cut into the existing plaster and the mineral wool is then pumped into the hollow partition to a pressure of ten pounds per square inch. The result, which complies with Department standards, is a five and a half inch wall with a thick inner fireproof core. By effectively withstanding a temperature of 1700 degrees, Fahrenheit, for one hour, such a wall prevents the spread of the fire and permits the safe evacuation of the building.

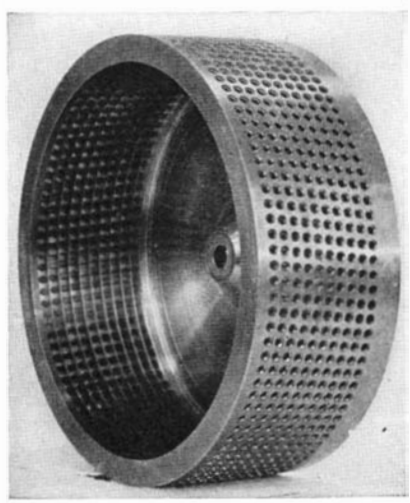
STEEL

DURING 1939, the research program of the steel industry contemplates a total expenditure of approximately $10,000,000. This is 15 percent more than the total of $8,700,000 which was spent for the same purpose in 1929.

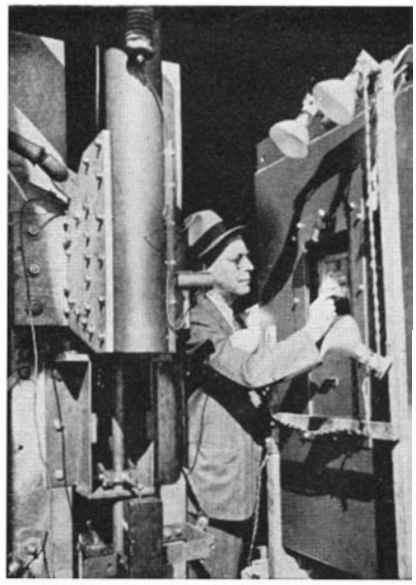
120,000 Pictures Per Second

WHAT is believed to be the fastest camera in the world, shooting 120,000 pictures per second, does not employ glass lenses. Instead, it has 1000 holes .01 of an inch in diameter, or approximately the size of a pin-hole. The drum-like camera is used in the study of electrical arcs so that engineers may analyze the behavior of such arcs in circuit breakers and other electrical apparatus.

The cylinder is 14 inches in diameter and is driven by a ½-horsepower motor which speeds up to 7200 revolutions per minute. At such a speed, each of the 1000 pin-hole



Pinholes — 1000 of them — are mounted within the larger holes on the high-speed camera cylinder



The pin-hole drum, carrying film of the high-speed camera, revolves behind opening at right center

openings is open for only 1/120,000 of a second. The size of each of the 1000 pictures taken by the camera, with a single film, is nine millimeters square, or about one third of an inch on a side.

While intended primarily for the study of electric arcs, other applications for this camera may be found.

The Chemical Structure of Vitamin K

CHEMISTS working independently at two different institutions, Harvard University and Saint Louis University, have determined the structure of vitamin K, the blood-clotting principle. The structural formula, according to the chemists, is 2-methyl-3-phytyl-1, 4-naphthoquinone.

The synthetic vitamin was checked by comparing spectra, color reactions, antihemorrhagic activity, and chemical properties, with those of the natural vitamin obtained from alfalfa.

The synthesis is declared to be an efficient and practical one suitable for manufacturing purposes, and the pure vitamin is thus made available for use in medicine to prevent and control hemorrhages.

Versatile Dehydrator

THE Henry Cartridge Dehydrator, originally designed for air conditioning and refrigeration, is finding increasing use where need exists for removal of moisture from chemicals in solution, and in air drying.

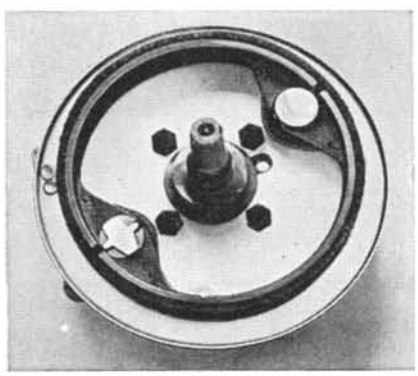
The major features of this Henry dryer are its patented dispersion tube and replaceable dehydrant cartridge. The perforated dispersion tube—exposing the entire volume of dehydrant to penetration by the fluid or air—extends along the center axis of the dehydrant column. This construction is claimed to reduce the pressure drop, prevent channeling and resultant loss of efficiency so often found in dryers of conventional design.

Refill cartridges make recharging of these Henry dryers exceptionally simple and easy. Cartridges are available charged with acti-

vated alumina, Drierite, barium oxide, calcium oxide, or anhydrous calcium chloride. The flange shell construction of the dryer, which is distortion-proof, speeds removal and replacement of cartridges. Dehydrators are obtainable in a complete range of capacities.

"Floating" Brake Lining

A SINGLE piece of "floating" lining is a novel feature of a new design brake adopted for the recently-announced Crosley car. This lining is not riveted, but "floats" freely between the brake shoes and the drum, thus affording braking action on both its surfaces instead of only one side as in conventional brakes. An interesting feature of this brake is the "creeping" or slowly rotating action of the lining, which distributes wear evenly over the entire lining surface, thereby greatly increasing its service life.



The lining "floats"

Should it be necessary to replace the lining after prolonged service, it is necessary only to remove the wheel, withdraw old lining by hand, and merely slip a new length of lining in place.

The brake shoes, which provide about 350 degrees of contact with the inner lining surface, are made of a special nickel-chrome iron sufficiently flexible to conform exactly with the drum contour when braking pressure is applied.

Falling Diamonds

DIAMONDS actually fall from the sky. That real diamonds exist in meteorites has just been demonstrated for the first time by X-ray examination of hard, black crystals in a specimen from the celebrated Meteor Crater in Arizona.

The present specimen was obtained not long ago by the Smithsonian Institution, and some of the suspected diamond inclusions were ground out. They were turned over to mineralogists of the Geophysical Laboratory of the Carnegie Institution of Washington for study by the most refined methods, with the result that the true nature of the inclusions no longer is in doubt.

The conditions under which meteorites probably were formed would be favorable for the formation of diamonds, provided the requisite carbon was there in the first place.

Demonstration that the inclusions actually are diamonds recalls the futile efforts made to drill into Meteor Crater in the hope that a big diamond mass would be encountered. After drilling straight downward for about 1200 feet the drills struck a resistant

material through which they could not penetrate. Efforts to sink a shaft were defeated by striking water. Geophysical experiments indicated a very heavy mass in the neighborhood. None of this, of course, would be accepted by geologists as positive evidence of the existence of a large diamond mass. There is even some question as to whether the "shooting star" responsible for forming the Meteor Crater actually penetrated the earth at all. It may simply have exploded and its fragments scattered over the neighborhood where many of them have been picked up in the past century.

The diamonds found in the Smithsonian Institution specimen are not of gem quality. They are very good black diamonds—even more valuable than medium-rate gems because of their use in industry.

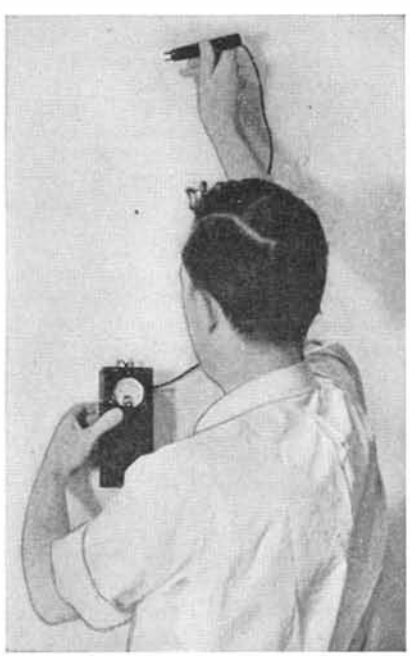
Sweets for High-Flying Bombers

SWEET emergency rations may be carried by pilots of bombing planes cruising at 11,000 to 20,000 feet altitude and peering at the darkness of a blacked-out city, to counteract difficulty in reading their brightly lighted instruments. This may be concluded from experiments reported by Dr. Ross A. McFarland.

Adaptation of the eye to dark and light is seriously affected by lowered oxygen pressure, Dr. McFarland and Dr. W. H. Forbes found at Harvard University, but the effect can be counteracted by a dose of glucose. The eye fails to adapt normally because the amount of oxygen in the nervous tissue is decreased. The trouble is in the nerve elements of the retina and central nervous system, not with the photo-sensitive substances in the eye.—*Science Service.*

Wall Moisture Detector

PAINTERS, plasterers, architects, building managers, waterproofing contractors, and others will find use for a new and simple instantaneous moisture detector announced by Colloid Equipment Company,



To record wall moisture content

Inc. It is used for testing plaster, brick, or concrete surfaces before decorating them, or for tracing leaks. It gives instantaneous readings of "dry," "wet," or "very wet."

This device is a simple electrical meter with an extension cord on the end of which is a handle containing two projecting needles. These needles are punched into the surface being tested, thus completing an electrical circuit. The flow of current between the needles and through the wall at that point will thus register on the dial of the meter without any calculations, the amount of current flowing being dependent upon the moisture of the wall. The circuit used is said to insure the highest possible accuracy regardless of whether the enclosed battery is new or old. The dial may be calibrated to meet special conditions.

Yawls for the Naval Academy

As a result of efforts over a number of years of high Navy officers to obtain up-to-the-minute sail boats for the Naval Academy for instruction in seamanship, the Luders Marine Construction Company

Practical seamanship is learned by midshipmen on yawls such as this

was awarded on their competitive design the contract for building three Navy yawls: *Intrepid, Alert,* and *Resolute.*

Each of these boats is 44 feet overall, 11 feet beam, and 6 feet draft, with 965 square feet of sail and 9000 pounds of lead in its keel. Accommodations are for eight midshipmen.

They are designed to be the last word for ocean racing and are equipped with Diesel engines as auxiliary power. They will give the midshipmen many opportunities to race against civilian yachtsmen and are the forerunners of an expected fleet of 12 to 18 boats.

Poison Gas

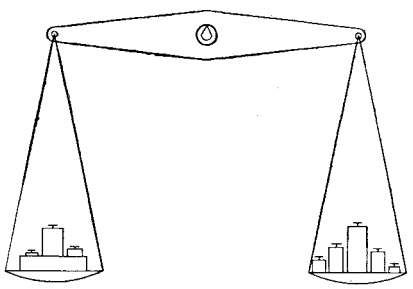
Here are the most important known poison gases which have been found effective in warfare. Many of them were developed and used during the World War. Possibly others, in addition, will be used during the present war in Europe.

Mustard Gas. Chemically, dichloroethyl sulfide. In pure state almost odorless. In World War smelled like mustard or garlic.

The Problem of the Weights

CONTINUING our series of mathematical brain-teasers, we offer the Problem of the Weights. It is, according to the author, a paraphrase of one which is over 300 years old, and one of the few really good problems in arithmetic. The answers and the solution will be given next month. Meanwhile any correspondence concerning this or previous problems should be addressed to Lieutenant Commander Leonard Kaplan in care of Scientific American, 24 West 40th St., New York, N. Y. All letters will be forwarded unopened.

It is desired to obtain a set of eight weights for a beam balance such as is shown in the accompanying sketch. They are to be



used for weighing to the nearest ounce any object up to, and including, 205 pounds. Each may be used on the left scale pan, or on the right, or not at all. The problem consists of three parts as follows:

I) Determine the magnitude of each weight.

II) Prove that eight is the least number, and, that

III) These eight weights have the least total weight of any set which will fulfill the conditions of the problem.

Heavy, oily liquid of dark straw color. Evaporates slowly at ordinary temperatures; thus is a persistent type of gas. Frequently diluted with another poison, chloropicrin, to keep it liquid in colder weather. Has a delayed action on body. First symptoms, itching and blistering. Especially damaging to eye's cornea. In eye, tissue degeneration begins two minutes after exposure to dilute concentrations. If gas is swallowed, symptoms of nausea, vomiting, and diarrhea develop. Gas very penetrating. Goes through ordinary clothing, rubber, and even leather. Is 50 times more toxic than chlorine.

Chlorine Gas. First gas used in World War. Two and a half times the weight of air. Clings to ground. Fills shell holes, depressions, and dugouts. Greatest action occurs in presence of moisture. Major action is on respiratory tract with symptoms of choking, coughing, and suffocation.

Phosgene Gas. A combination of carbon monoxide and chlorine. Resembling chlorine in action but has a more delayed effect. Is 10 times more toxic than chlorine. First symptoms very minor. Its effectiveness mainly due to initial innocuous character. Its menace is revealed only after considerable gassing has occurred.

Lewisite. Chemically, chloro-vinyl-dichloro-arsine. Developed secretly during World War by Capt. W. Lee Lewis of U. S. Chemical Warfare Service. War ended just before gas entered combat use. Has all blistering properties of mustard gas but more effective because it has ability to penetrate the skin. Three drops, placed on rat's abdomen, causes death in two to three hours. Is powerful respiratory irritant. Produces violent sneezing. Another variety, beta-beta-prime-chloro-vinyl-dichloro-arsine, has less blistering effect but its irritation on respiratory system is much more severe.

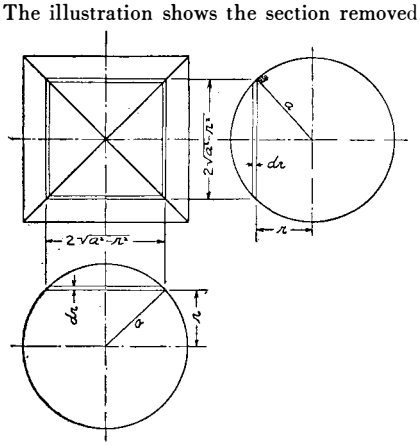
Toxic smokes. Chemically, diphenyl-chloro-arsine and diphenyl-cyano-arsine. Popularly called sneezing gas. Are really finely divided dusts. Can pass through ordinary gas masks unless special filter attachments are provided. Effective in concentrations of one part in 10,000,000 of air. In higher concentrations, cause vomiting. Considered as poisonous as phosgene in equal concentrations.

Crying Gases. Twenty-three different varieties used in World War. All intended to produce temporary disability and confusion. Favorite German lachrymatory gas was xylyl bromide. Among the Allies, chloropicrin was widely used.—*Science Service.*

Solution to the Problem of the Intersecting Cylinders

THE problem offered last month was to find the volume of the material removed from a two-inch cylinder by a two-inch drill. The axis of the drill was perpendicular to and intersected the axis of the cylinder.

Here, as was promised, is the solution. The illustration shows the section removed



from the cylinder. The radius of the cylinder is equal to the radius of the hole and has been designated as a.

Taking sections in the manner indicated, the volume, V, will be given by the expression:

$$2\int_0^a (2\sqrt{a^2-r^2})^2\,dr$$

$$8\int_0^a (a^2-r^2)\,dr$$

which integrates into

$$8\left[a^2r-\frac{r^3}{3}\right]_0^a$$

$$8\left(a^3-\frac{a^3}{3}\right)$$

Hence,

$$V=\frac{16}{3}a^3$$

And so for the specific value, $a = 1$ inch, given in the problem, the volume of material removed is 5 1/3 cubic inches.

YOUR FIREARMS

Conducted By A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor.

Introductions Are In Order

THE brotherhood of nimrods, gun fanciers, and gun hobbyists is one fraternity which particularly and readily lends itself to new and lasting friendships. This introduction of "Your Firearms" to Scientific American readers is performed, therefore, with the pleasurable anticipation of engaging with kindred souls in monthly round-table discussions and arguments in an informal, pipe-smoking sort of fashion. Inasmuch as it's "Your Firearms" we're going to discuss, we will endeavor to chat about the things in which *you* are interested.

It's a vast and controversial subject, this matter of guns and ammunition, and there may be times when you heartily disagree with what we have to say. By the same token there will be other instances when you are in accord with the thoughts expressed, but in any event, it is your department, conducted for your pleasure and your information. Ranging through the fields of shotguns, rifles, handguns, their applications, ammunitions, and all their various affiliated gadgets, we plan to present unusual and informative angles, current news, and timely data on new developments. Our mail box is of generous proportions—we sincerely trust you will test its capacity to the fullest extent.

Bird Season Shotguns

WHEN the old-time angler selects a new trout rod, he doesn't whip it as a David Harum might lay his buggy lash onto the old mare's flanks. He picks it up with the same delicate reverence that a jeweler imparts to the presentation of a beautifully made watch. He tests the rod's balance; the tip waves gently as, with an easy wrist motion, he gets the general "feel." Your experienced bird shooter handles a prospective shotgun purchase in much the same manner. It's the "feel" of the weapon which tells him what he wants to know.

Incorporated in that "feel," however, are several factors, tabulation of which, to the veteran gunner, are more or less subconscious. The weight, balance, pitch, fit of stock, drop at comb and at heel are all integers which collectively contribute to an instantaneous reaction during the first moment or two with a new gun. The aforesaid veteran is entirely conversant with these component items, but he doesn't delve specifically into them until after he has applied his first automatic testing formula of "feel."

Should the reaction be negative, even in the least degree, the piece is either laid aside in favor of another, or the purchaser hefts the gun, tries it rather questioningly to his shoulder again, as if that shadow of doubt which first crossed his mind might have been an error. The chances are, though, that if the gun "feels" wrong, he can't be persuaded to try it, and if he does, the resultant lack of complete confidence will affect his shooting.

All this applies to the man who knows his guns. How then, to answer the novice, the new chap, who asks: "Which shotgun should I buy?" The logical answer to that one is, of course, another question: "What game do you want to shoot?" But this doesn't give the neophyte much satisfaction. However, we can say that stock fit, portability, trigger pull, gage, gun balance, lines, and certain minor mechanical details are primary features to be considered in selecting a field gun. Let the novice forget momentarily the more technical angles.

The author afield

Regardless of weight, gage, balance, or bore the gun must fit the gunner or the results will be disappointing. A beautiful and expensive field piece may be utterly useless if the stock is either too short or too long. The best we can say is to find a gun which feels "right" when it comes up to the shoulder—just as you feel "right" in a properly fitted new suit of clothes—and stay with it long enough to give it an adequate trial. If, then, you can't hit what you aim at, take it back for a check-up of all phases.

We have listed portability, or weight, as the second item for consideration because it is the exceptional city dweller today who can walk three or four miles without feeling tired. In our estimation field guns should range between 6½ pounds and 7 pounds 6 ounces when empty, and while that may not seem like much gun to carry, there are also shells, frequently heavy clothing and, it is to be hoped, some game.

Trigger pull in your shotgun is as important as acceleration in your motor car. Both are vital factors in performance and safety, and, just as acceleration in automobiles is not always satisfactory, so in many shotguns the trigger pull will not be perfect. A 4 to 5½ pound trigger pull on a double barrel, 12-gage gun weighing around seven pounds will be found to be pretty close to correct, and although lighter pulls in lighter pieces may be smoother, too much reduction in the pressure brings in the problem of accidental discharge.

As to gages, it is quite universally agreed that the 12, 16, and 20 are the popular sizes in field guns throughout the country. To attempt to designate whether that new gun should be an automatic, a pump, a double barrel, or one of the over-and-unders would be rather like trying to tell the trout fisherman which fly to use. We do feel, though, that if you've been used to rifle shooting, you will find the single sighting plane—that is, the pump, the automatic, or the over-and-under—better suited to you.

Regardless of which gun is eventually chosen, remember, it is like your golf clubs, your tennis rackets, your trout or bass rods. All require constant use and practice to get the most out of them, and that, we might observe in closing, is one reason why we have so many skeet fields.

Pot-Shots

AT THINGS NEW

WINCHESTER AND WESTERN SUPER TRAP AND SKEET LOAD now available in standard shells featuring a new crimp. In this departure from the time-worn method of placing a card wad over the shot, these companies have joined Remington, who announced their new crimped shell last spring.

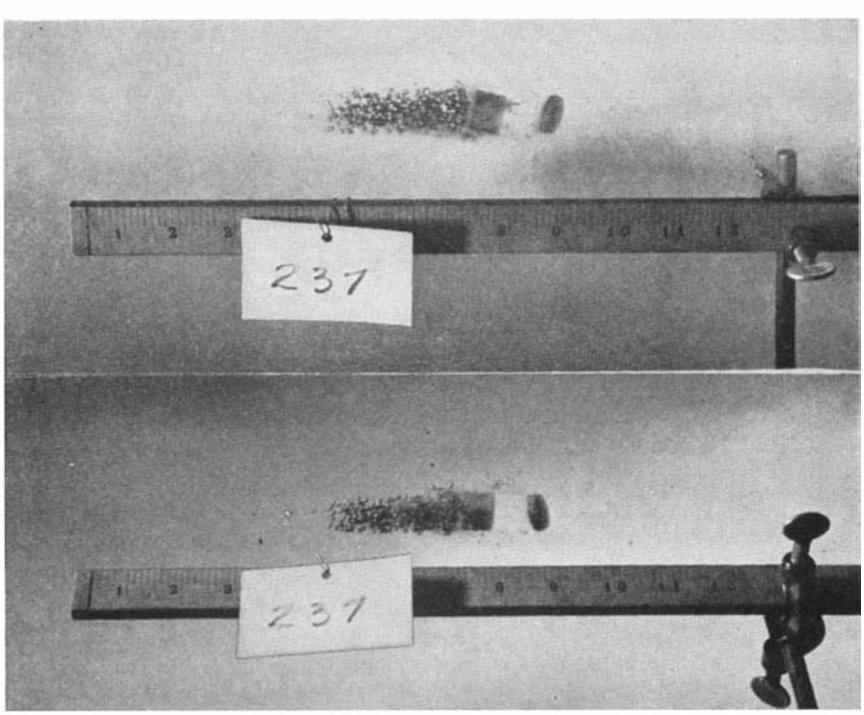
Using two cameras taking instantaneous ultra-high speed exposures, the two accompanying pictures by flash photography show how the shot charge from the same crimped-shell load is propelled targetward—from right to left. The upper photograph looks down at the charge from an angle of 45 degrees, while the lower photograph looks up at the same angle. Use of the crimp has eliminated the top wad, conspicuous by its absence in the illustrations, and with no such source of interference to expand or scatter the charge, there can be no so-called "doughnut" patterns. Attention is called to the Seal-Tite wad, which has served as a piston, and which is seen dropping away from the charge.

Averages taken from 100 fired 30-inch patterns at 35, 40, and 50 yards showed how the spread of the original dense pattern center is controlled, resulting in remarkable uniformity of the number of pellets in the outer six-inch ring of the 30-inch targets. The averages were as follows:

	Inner 18-inch ring	Outer 6-inch ring
At 35 yards	218 pellets	160 pellets
At 40 yards	172 pellets	159 pellets
At 50 yards	137 pellets	157 pellets

COMBINATION .410 AND .22 is Marlin's latest gun in the over-and-under design. The top barrel takes .22 short, long, and long rifle cartridges and features the famous Ballard rifling. The bottom barrel is for .410 bore 3-inch shells and is full choke, with specifications similar to the .410 over-and-under

shotgun. The Marlin factory will also furnish on order .218 Bee or .22 Hornet barrels in combination with the .410 bore and either of these can also be fitted with an extra set of .410 bore, 26-inch barrels.



Start of a "doughnutless" pattern

Conducted by JACOB DESCHIN, A.R.P.S.

TRICKS BY REFLECTION

FROM the simple reflection in a mirror or body of water, to the many and varied surfaces in which an object is reflected by the familiar "agency of light," photographs by reflection have been a popular pastime for a long time. Their popularity never pales because of the great variety of effects that may be obtained. There is no great photographic problem to surmount, but there are frequent instances in the work of amateurs where a better understanding and appreciation of reflection photography would have improved the result.

At the moment, we can think of five principal things that should be taken into account in producing good reflection pictures. These are as follows:

Figure 1

1. The light used should illuminate the subject and be shielded from the reflecting surface itself as much as possible, for wherever the light strikes the surface the subject reflection is partially or totally lost.

2. In focusing for the reflected image, the focal point is not the face of the reflecting surface, but twice the distance from the position of the subject to the reflecting surface. However, this will obtain only from the point of view of the subject. That is, it would be true if the camera were placed alongside the subject or at some point to the left or right of the subject, on a plane with the latter, equally distant from the reflecting surface. Since this is not always the case, the more practical way to put it is to say that the point of focus is the distance from the subject to the reflecting surface plus the distance from the surface to the camera.

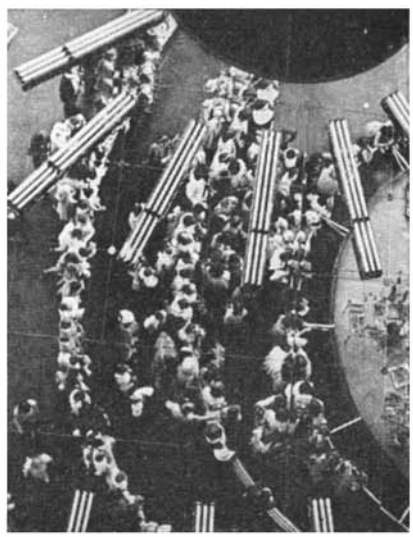


Figure 2

3. The angle of the camera should be such as to make the most of the reflection, which is the chief reason for the picture. This may sound like unnecessary advice because seemingly so obvious but a glance at some reflection picture efforts will show how frequently these pictures show the reflection in a position of minor emphasis.

4. Adequate exposure for the reflection, depending on the reflecting capacity of the particular surface used, is another point to watch. An exposure that will be correct for the subject itself under a given intensity of light will not always be right for the reflection. A mirror or calm body of water will give off the brightest reflections, prac-

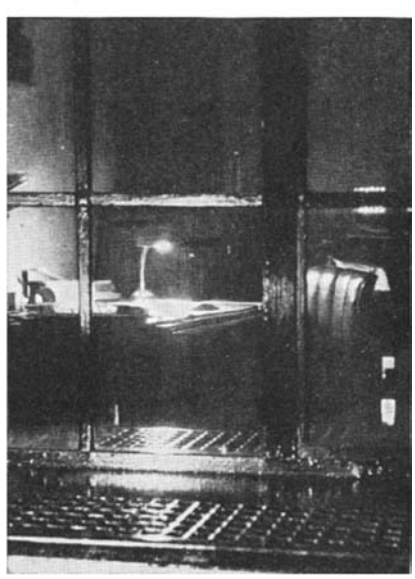


Figure 3

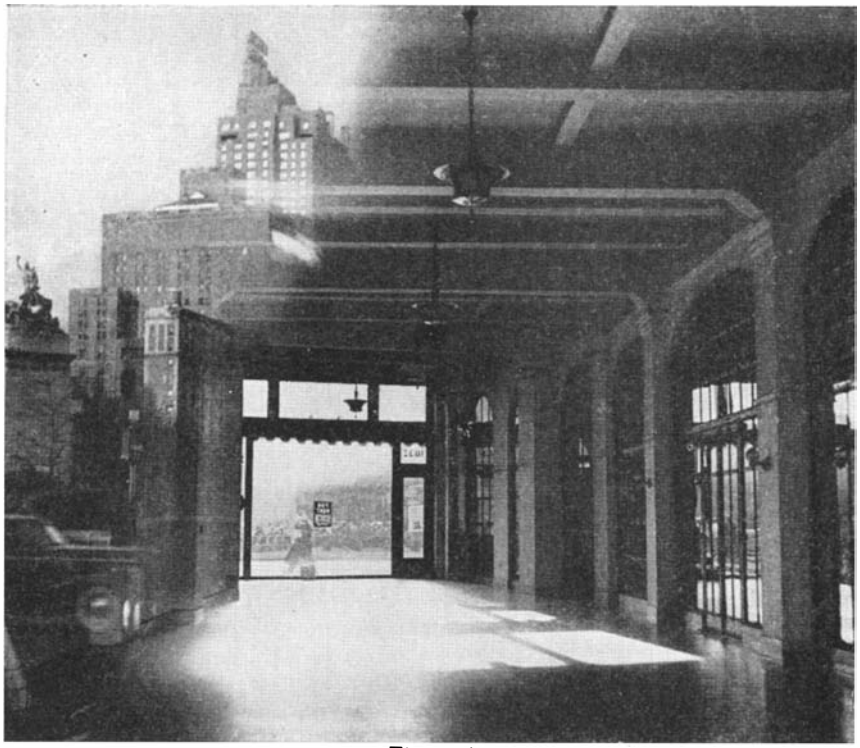


Figure 4

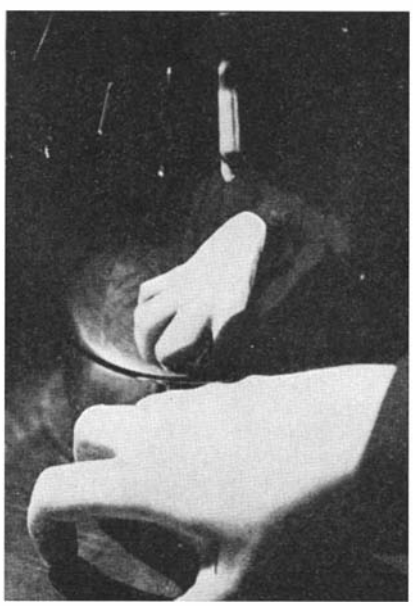


Figure 5

tically equal to that of the subject direct. A less efficient reflector may take twice as much exposure or more.

5. What cannot be accomplished completely by point 3 in the matter of properly composing the reflection picture should be done in the printing or enlarging through "framing" or masking. More than is desired may be included in the picture because of the focal length of the lens or because of an enforced distance from the subject.

Figure 1 illustrates a straight reflection in water puddles, plus the subject itself, while Figure 2 might be termed a sort of trick effect in an ordinarily straight reflecting surface—a mirror. A ceiling comprising a number of separate mirrors joined together "breaks" and duplicates subjects wherever the latter appear at the mirror joints. The triple "straw"-like units are tubular lamps.

At night an ordinary window will serve as a reflecting surface almost as efficient as a mirror. Witness Figure 3, in which a desk and chair, even the door of the room, are faithfully reflected in the window, through which also may be seen the lighted windows in buildings in the distance. Inclusion of the window helps to clarify the picture.

A curious trick effect is shown in Figure 4, which was photographed through a window facing the street at the other end of an empty store. The late afternoon sun coming from the direction of the window shown in the picture illuminated the buildings reflected in the left third of the picture.

Figure 5 is an example of distortion by reflection and foreshortening, or close viewpoint. The reflecting medium is an aluminum surfaced coffee pot. The odd vertical reflection is the face of the subject, which was reflected upright from the convex part of the pot and inverted from the concave upper portion.

Double-Duty Filters

PERSONS who own both a Contax and a Super Ikonta B are advised that a threaded adapter ring is available for the latter camera which will take the same filters as those used on the Contax, as well as the lens shade. Thus, the filters purchased for the Contax will serve for the other camera as well, eliminating the necessity of purchasing a separate set of filters for each of the two cameras.

Ground Level Viewpoint

ONE of the most frequently heard taboos is the one that advises never to have the camera face the subject head-on because such a pose is bound to lack interest. However, like other rules and regulations meted out to photographic workers, this one may sometimes be broken with impunity. Here

You Can Win one of 27 PRIZES

Over $1300 in AWARDS

Fourth Annual SCIENTIFIC AMERICAN AMATEUR PHOTOGRAPHY CONTEST —

EVERYONE who owns a camera has a chance of winning a valuable prize. Plan now to enter your prints in this contest. You may enter any or all of the three divisions, but not more than two prints may be entered by one contestant in any one of the divisions.

Specific rules for this contest are published below. Be sure to read them before you submit prints.

RULES of the Contest

- **1.** The groups will be judged independently on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.
- **2.** Prints must not be smaller than 5 by 7 or larger than 11 by 14. Prints need not be mounted, but may be at the contestant's option.
- **3.** Photographs must be packed properly to protect them during transportation.
- **4.** Non-winning entries will be returned only if sufficient postage is included when the prints are submitted.
- **5.** Each entry must have the following data written on the back of the print or mount: Name and address of contestant, type of camera, and film, enlarger and paper used.
- **6.** Contestants may submit no more than two prints in each group, but may enter any or all groups.
- **7.** Prints must be in black and white. Color photographs are not eligible.
- **8.** Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.
- **9.** Scientific American reserves the right to purchase, at regular rates, any non-winning entry.
- **10.** No entries will be considered from professional photographers.
- **11.** All entries in this contest must be in the hands of the judges by December 1, 1939. Results will be announced in our issue dated February 1940.
- **12.** This contest is open to all amateur photographers who are not in the employ of Scientific American.

Prizes for BEST PHOTOGRAPHS in EACH DIVISION follow:

First Prize
One $250 "Lifetime" LONGINES Watch*

Second Prize
One $125 LONGINES Watch*

Third Prize
One FEDERAL No. 636 Variable Projection Printer
(List price $29.50)

Fourth Prize
One FEDERAL No. 120 Enlarger
(List price $17.95)

Five Honorable Mention Awards, each consisting of a one-year subscription to Scientific American

Remember that these prizes are to be given in each division—or a total of six watches and six enlargers plus 15 subscriptions to Scientific American, totaling $1,327.35 in value.

*** First Prize watches are standard men's pocket models. Second Prize winners may choose pocket style or gentleman's or lady's wrist watch.**

Submit Pictures in ANY or ALL Three Divisions:

Division 1. Human—including portraits and other camera studies of people.

Division 2. Landscapes—including all scenic views, close-ups of parts of landscapes, seascapes, and so on.

Division 3. Action—including all types of photography in which action is the predominating feature.

In each division there will be prizes of two Longines watches—"The World's Most Honored Watch"—and two Federal Enlargers, as well as five Honorable Mention Awards.

This Contest Closes Dec. 1, 1939—All Entries Must Then Be in Hands of Judges

Address All Entries to
PHOTOGRAPHY CONTEST EDITOR
SCIENTIFIC AMERICAN
24 W. 40th St., New York City

THE JUDGES:
McClelland Barclay, artist
Ivan Dmitri, artist and photographer
Robert Yarnall Richie, commercial photographer

is one that we believe does so successfully. Taken on the beach in mid-afternoon, the cameraman crouched on his tummy to face the subject eye to eye and shot away just as a fortuitous breeze waved the towel revealingly out of the way. The arrangement of the towel around the subject's head, the

From ground level

revelation of only one shoulder, the highlight on one side of the face, the waving hair, the pose of the subject's left hand and the curious smile, each lends its bit towards the whole. Unfortunately, the right hand, holding the lighted cigarette, is out of focus owing to too near a camera viewpoint and the wide diaphragm opening necessitated by the fact that the subject was in shadow.

Prize Change

DUE to war-time conditions in Europe, and uncertainty as to shipping schedules, we are forced to make a change in the First Prizes offered in our Fourth Annual Photography Contest. As originally announced, First Prize Winners would make their own selections of watch styles from the line of $250 "Lifetime" Longines watches. Now, however, this must be changed and, as conditions stand at present, First Prize Winners will be presented with $250 "Lifetime" watches in the pocket style. Second Prize conditions have not been changed.

Saturated Solution

OCCASIONALLY the beginner comes across the phrase, "saturated solution," and wonders about its meaning. In preparing a saturated solution, a sufficient amount of the chemical is poured into a quantity of water so that some of the chemical is left undissolved. In other words, pour in a little more chemical than a given quantity of water will dissolve. The amount of chemical required will vary with the temperature—the warmer the water the more chemical will be needed; the colder, the reverse.

Makeshift Spotlight

SHOULD you have need for an extra spotlight some evening, you can provide yourself with one in a jiffy. Cut a sheet of cardboard or tin sufficiently large to cover up the front of one of your flood lights. In

the center of this cover cut a hole and insert a tin or cardboard tube. When you have attached the cover to the front of the light and snapped on the switch, a narrow beam of light will be the result. To control the angle of this beam, you may have two tubes, one sliding within the other. The longer the extension used, the narrower will be the beam.

Sports By Synchro-Flash

DESPITE the growing popularity of synchro-flash photography, in which snapshots in daylight are made with a flash gun, the photographer employing this means frequently is questioned as to the reason for using a flash when there is available

By synchro-flash

such a largess of daylight. Such was our experience one day as we were synchro-flashing an outdoor game. In order to get a good tone in the sky, we employed an orange filter. The picture was made as the player struck the ball with his fist. The use of the flash helped to balance the light between the shadow areas and the sunlight. We expect shortly to present an article on the general subject of synchro-flash photography.

Dustless Tank Reels

THE popular Bakelite developing tank reels sometimes give trouble by collecting small dust specks within the grooves, thus causing undeveloped spots on the film. As the reel is revolved in the tank the dust is loosened and makes its way to the surface of the developing film and blocks development wherever it lands. One way of avoiding this is to give the loaded film a preliminary rinsing in water. But, of course, the best thing is to remove the offending dust and specks altogether. Drying the reels in a dust-free place is the way to do it. As soon as they have dried, they should be immediately put away in a closet or drawer.

Success Story

TO date Nathaniel Field, 33-year-old Brooklyn, New York, accountant and perennial picture-prize winner, has earned and won a total of about $1,500 in cash, prizes, and merchandise. His latest victory

was the capture of a first prize in the Ford Exposition's Photo Contest at the New York World's Fair. Mr. Field, who is believed to have embarked on a photographic hobby career with the birth of a son about two and one half years ago, started with a very inexpensive camera, and kept trading in for better ones until, about eight months ago, he bought his present camera, an enlarger and all that goes with it, and started doing all his own work.

Mr. Field won two prizes in the National Motor Truck Show last winter, and his flash picture of a girl on a circus horse was awarded the $25 first prize for the "Best Picture-of-the-Month" by *Popular Photography*. Many firms have bought pictures from him for use in advertising or promotional work. The New York Central Railroad bought a series he made inside Grand Central Station. As this issue goes to press we learn that T. J. Maloney, publisher of the *U. S. Camera Annual*, has notified Mr. Field that one of his pictures has been selected by Edward Steichen for the 1940 edition.

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please accompany your request by a stamped envelope.

KODAK PRECISION ENLARGER ($67.50, including stand assembly, bellows assembly A, and condenser head A, with choice of condenser, No. 212 Mazda photo enlarging lamp, and one glassless negative carrier, but without lens): Adaptable to direct photography, copying, titling, photomicrography, production of enlarged prints, lantern slides, film positives, color-separation negatives.

Covers range of negative sizes from 35mm up to 2 1/4 by 3 1/4 inches, permitting enlargements 11 by 14 inches and larger on baseboard. Enlarger head may be turned for horizontal enlargements on wall. Basic enlarger comprises three units: Stand assembly—five-ply, natural finish, laminated wooden base, 35-inch chrome-plated column 1 1/2 inches in diameter, and sliding bracket; bellows assembly A—die-cast aluminum back frame which attaches to sliding bracket of stand assembly and carries gray bellows, die-cast aluminum front board which accepts 2 5/8 inch square aluminum lens board, and nickel-silver chrome-plated shaft on which front casting slides by means of positive friction-drive mechanism designed for fine focusing; Condenser head A—light-tight metal lamphouse containing opal projection lamp and condenser system, consisting of two optically ground and polished condenser lenses in metal mount with heat-absorbing glass located at top. Counter-balance in column head; slight turn of hand knob secures head at any desired height. Head itself may be swung and locked instantly at any position from vertical to horizontal: indicating

scale shows accurate vertical position as well as other positions up to 90 degrees off vertical. Head and bracket may be turned 180 degrees around column for projection to floor. Lenses available in three focal lengths and two complete series, one for black-and-white, other for color as well as black-and-white. Series of interchangeable condensers provided with handle for lifting. Each condenser has heat-absorbing glass and insulating ring between lamphouse and casting into which it fits, preventing conduction of heat below that point. Negative carriers are of new glassless type. Degree of enlargement indicated on paper board. Kodak Masking Paper Board available, of five-ply, natural finish laminated wood, with metal parts in neutral gray; three tilting legs available as accessory for paper board, making it possible to tilt board at any angle. Ruby filter attached to boss on lower bellows casting may be swung into position; diffusing disk may be attached below ruby filter. Enlarger may be used as copying camera by removing condenser head and substituting Camera Back Adapter A grooved to accept rear accessories of Kodak Recomar 18. Set of two adjustable copy lights attaches to sliding bracket. Microscope Attachment converts enlarger to photomicrography, in conjunction with microscope.

MERCURY TELEPHOTO 75mm LENS ($19.95): Speed *f*/3.5. Interchangeable with standard Mercury *f*/3.5 lens. Furnished in precision micrometer focusing mount. Objects at any distance brought sharply into focus. Magnification factor more than 2 to 1. "At the same time," say makers, "magnification factor is not so great that a slight movement of the camera in the hand would spoil the picture."

KALART RANGE FINDER BRACKETS ($2.50): Encircling brackets for Kalart Model F Lens-Coupled Range Finder for Speed Graphic cameras only. Protect range finder from knocks; eye-tube extension aids photographer to locate "bright spot" when focusing.

SUPER ROBOT CAMERA: Similar to Robot Model II, with exception of motor spring, which has been replaced by a more powerful motor spring to permit as many as 48 exposures without rewinding or resetting. Super Robot, particularly in connection with Robot Remote Control Release, useful for scientific photography, for recording extremely fast motions, and in all cases where full magazine load is to be exposed without approaching camera.

BEE BEE RANGE FINDER ($4.35; leather case, 40 cents): Superimposed type range finder focusing from 2 feet to infinity. Chrome finished. Weight approximately 2 ounces; measures 3 3/16 inches long and 7/8 by 1 inch overall.

LEITZ ANASTIGMAT SUMMITAR 50 mm *f*/2 LENS ($114): For Leica camera, in collapsible focusing mount. Said to embody improved definition over entire field of image, higher degree of chromatic correc-

tion throughout visible spectrum, increased marginal illumination of image. External appearance similar to Summar 50mm lens, except that diameter of front element is much greater. New type optical glass used for front element, protecting lens surface against adverse climatic conditions. Special collapsible sunshade available for Summitar as are the Leitz filters, in screw-in mounts.

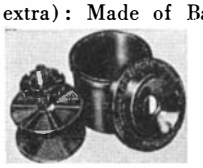
LAFAYETTE HOME-MOVIE SCREEN: Crystal beaded screen reflecting four times light of ordinary diffusing screen over angle of 25 degrees. Wood frame also serves as base. Screen 30 inches high by 40 inches wide supported by metal post. Said to be free from halation, both in front and from sides. Weighs approximately six pounds.

MUNDER COLOR-FLASH LAMPS (30 cents each): For use with any daylight type film or plate indoors or outdoors. Designed to produce illumination that has same color characteristics as bright sunlight. Also may be used with any tungsten or Photoflood type film. Munder No. 20B, 21 milliseconds to peak of flash; flash duration, 1/25 of a second; voltage required, 1½ to 125 A. C. or D. C.; all lamps safety-coated.

LAFAYETTE "IN-SLIP" MOUNTS: Available in 22 sizes. Types for both horizontal and vertical prints. Openings vary from 3 1/8 by 3 3/4 inches to 10 1/2 by 13 1/2 inches, meeting needs for all standard size prints up to 11 by 14 inches. Mounts are of choice white antique finished material. Traced margin around window opening provides decoration. Another series especially intended for exhibition prints free from decorations of any kind, available for vertical and horizontal mounting of 8 by 10 and 11 by 14 inch prints.

ARGUS MODEL M CAMERA ($7.50): Takes single or double frame pictures, twelve 1 by 1 1/2 double frames or 24 single frames. Equipped to work as close as 24 inches. Shutter marked "dull," "cloudy," "bright," "sunshine," or "color." Triplet Anastigmat *f*/6.3 color corrected. Uses specially spooled Dufaycolor film and new 35mm Arguspan film.

F-R "SPECIAL" ADJUSTABLE ROLL FILM TANK ($1.85; double flange, 50 cents extra): Made of Bakelite, with stainless steel parts. Adjustable to all popular sizes roll film from complete 36-exposure 35mm roll up to and including 116. Film may be loaded into reel from either inside or outside (or both when loading more than one roll). Because of inside loading feature, films may be developed in rapid succession irrespective of how wet reel may be. Only eight ounces of solution necessary for 35mm roll; total capacity of tank 16 ounces for largest size film. Revolving light trap stops light from entering funnel and aids quick filling and distribution of solution over film. F-R patented check stop prevents film unrolling during agitation. Double flange permits developing two full length rolls of 35mm. Knurled agitating ring built onto reel; permits thermometer to be used during development and agitation.



CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

***Q.* I have heard that the backs of negatives may be so treated as to permit working on them in order to modify the image. Will you please explain how this is done?—C. S. K.**

A. Prepare the following formula:

Sandarac	18 grains
Mastic	4 grains
Ether	200 minims
Benzol	80 to 100 minims

This is spread evenly over the back of the negative. When dried, the resulting matte permits the application of charcoal or crayon for the purpose of intensifying details or masses, adding clouds, and so on. The fineness of the matte surface is determined by the amount of benzol used, the greater the amount, the finer the surface obtained.

***Q.* How long does it take for brown stains to appear on a print that has not had the hypo properly washed out of it?—F. L. D.**

A. No definite answer is possible, for it will depend on the amount of hypo left in the print and might take a few months, a few years, or longer. Of course, you know that various tests are available for determining whether a print has been washed free of hypo.

***Q.* I have been trying to use my camera, which takes vest-pocket film, for copying the printed matter in books, magazines, and so on. Employing Mazda (not Photoflood) illumination and the standard orthochromatic and panchromatic films in the standard fine grain developers has proved unsatisfactory, the enlarged prints being grayish and muddy from lack of contrast even when a hard paper is used. Would you advise getting a 35mm camera so that I may use positive, process, and other films of a contrasty nature? Or would a contrast developer, such as D-11, on film such as Panatomic X prove sufficiently contrasty for crisp prints?—J. R. B.**

A. For best results, showing clean-cut reproductions of the printed matter copied, positive film will be the most satisfactory. Development in the contrast developer D-11 at 65 degrees for five minutes, should prove ideal.

The fault has not been in your lighting, which is probably satisfactory, provided it is evenly distributed over the surface to be copied, but in your choice of film. In this type of work not only do you have no need of the color sensitivity of orthochromatic and panchromatic films, but this actually is a deterrent to satisfactory work. You might try the suggestion contained in the last sentence of your letter and see if the resulting contrast is sufficient for your purposes, but positive roll film in a 35mm. camera, or positive cut-film in a larger camera, will do the job in the most efficient way.

***Q.* Infra-red film with filter calls for 1/20 of a second at *f*/3.5. I have a Goerz Dagor *f*/6.8 lens. What will the exposure be for this lens at its widest opening?—M. S.**

A. If the exposure you cite for *f*/3.5 opening is correct, the exposure at *f*/6.8 will be four times as long, or, in this instance, 1/5th second.

***Q.* I have the opportunity of purchasing an old model camera, with a Tessar *f*/4.5 lens, which takes a six-exposure roll. The red window is in the middle center of the back. In examining the camera I find that the back section of the lens has been removed. How good is this lens with the two front elements only? Could you tell me if the six-exposure roll is easy to buy? I have the idea of using the 120 roll but I am not sure whether the numbers which indicate the exposures are marked all the way across the safety paper.—A. P.**

A. The lens cannot be used as it stands because the Tessar is of the so-called non-symmetrical type and therefore requires the use of all four elements which comprise the Tessar. The six-exposure roll is not now available in this country. By some experimentation, it is quite possible for you to work out a scheme whereby you could employ the 120 or similar roll-film size. The number markings on the back of the safety paper now include three rows, the left for the 8-exposure style camera, the right for the 12-exposure camera and the center for so-called vest-pocket, 16-exposure cameras. For your particular camera, because the window is in the center, you will have to use the center row as the basis for working out your particular requirements.

Our Book Corner

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ATOMS IN ACTION

By George Russell Harrison

APPLIED physics is the scope of this most readable volume by a professor of experimental physics and director of the research laboratory of physics at The Massachusetts Institute of Technology. Physics in agriculture; applications of the physics of sound; glass; electronics; radio; spectroscopy (this chapter appeared as pre-publication articles in the September and October numbers of Scientific American); physics in medicine, optics, television, music, air conditioning and aviation—these give the general scope. The treatment is the opposite of technical; your mother or sister could follow it easily to learn what these things are about—without being asked to learn too deeply. The author has a wide reputation as a facile expositor of applied science. (370 pages, 5½ by 8½ inches, 19 illustrations.)—$3.60 postpaid.—*A. G. I.*

NEW PATHS IN PHOTOGRAPHY

By Andreas Feininger

"OFF the beaten path" may be a trite expression but it surely applies specifically to this newest book on creative photography. The author first discusses various phases of photographic operation and processing, an understanding of which is necessary for an appreciation of the 47 full-page plates which follow. With this book as a guide, or as an inspirational source, the photographer will find the way open to unusual camera effects. (10½ by 11½ inches, 15 pages of text, and 47 plates.)—$2.85 postpaid.—*A. P. P.*

APPLIED ECONOMICS FOR ENGINEERS

By Bernard Lester

EXECUTIVES in industry have repeatedly pointed out that the technical graduate is handicapped by a lack of training in the practical principles of economics. The author of this book believes that the economic theories now prescribed for students are not applicable to present conditions in a practical way; hence this volume. In it, Mr. Lester has attempted to give (successfully, we believe) the sort of discussion which would quickly acquaint the technical man with the principal problems and human relations he should know if he is to conduct a business successfully. A successful engineer himself, with a nationally known corporation, the volume is built on his wide experience and observations. In content, it runs from a chapter: "Economics and the Engineer," through the whole range of engineering and industrial activities to a chapter entitled "The Engineer as a Citizen," and a further note on "Economic Studies." (463 pages, 6 by 9¼ inches.)—$4.10 postpaid.—*F. D. M.*

OF ANTS AND MEN

By Caryl P. Haskins, Ph.D.

A STUDY of the life of ants, especially with regard to their similarities with another social animal—man. Not a light, popular work and probably best suited to readers having a little previous knowledge of ants. (244 pages, 6 by 9 inches, 15 illustrations.)—$2.85 postpaid.—*A. G. I.*

THE BOOK OF INDOOR HOBBIES

By Emanuele Stieri

TERRARIUMS, window-box gardening, roof gardening, dish gardening, collecting cacti, aquariums, feathered pets, pottery making, leathercraft, plastics, pewtercraft, soap carving, chip carving, etching, and bookbinding—these are the indoor hobbies dealt with, chapter by chapter, in this book, about which one terrarium-aquarium-gardening hobbyist close to this reviewer says the treatment is practical and obviously prepared by an author who writes from his own experience. It makes a big difference in a book whether this is the case. (430 pages, 6 by 9 inches, 196 illustrations.)—$3.10 postpaid.—*A. G. I.*

MAN AGAINST MICROBE

By Joseph W. Bigger, M.D.

IT would be difficult to write a more lucid, more directly revealing, popular yet scientific, account of the rudiments of bacteriology than this book which this reviewer read from beginning to end as a pleasure and not as a task. It tells what microbes are, how they are cultured, identified (just enough insight into the intricacies to show the reader what it is that the mysterious bacteriologist does, without bogging him down with details); also what microbes do and the main points about immunology—toxins, antitoxins and so on (again just enough to satisfy the reader who wishes a clear elementary understanding without trying to become a bacteriologist or immunologist). It also tells the long story of man's conquest of microbes, and it winds up with a lengthy discussion of practical applications of bacteriology in everyday life. A meaty work. (304 pages, 5 by 7¾ inches, 35 illustrations.)—$2.60 postpaid.—*A. G. I.*

THE STORY OF SURGERY

By Harvey Graham

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By A. Hyatt Verrill

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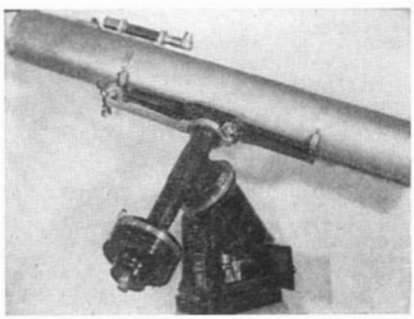


Figure 1: **Holcomb's heavy mounting**

amount of time on an optical surface until it is as nearly perfect as any optical surface can be made. In a few communities such amateurs or groups of amateurs have concluded or are concluding arrangements with local educational institutions—high schools, colleges, universities—to make and install telescopes for their mutual advantage. For example, the educational institution contributes the materials, also a permanent site for the observatory. The amateurs put in the skill and the elbow grease. The finished observatory is then available to both (often, also, to local townsmen).

The 12″ reflecting telescope shown in Figure 1 was made by an amateur, J. M. Holcomb, 40 Clarke St., Burlington, Vt., for St. Michaels College in Burlington's suburb, Winooski. Asked to describe it, Holcomb states:

"The mounting is compact and rigid, operates smoothly, and is convenient to use. The setting circles are divided to half degrees and are illuminated. The driving clock (Figure 2) is run by a synchronous motor and is adjusted to sidereal time. The mounting is also provided with slow motion controls, that in declination being manual, that in right ascension motor driven.

"The building (Figure 3) consists of a 12′ by 26′ classroom on ground level and a wooden-framed, metal-sheathed dome 12′ in diameter, 9′ high, above. The telescope rests on a ten-ton reinforced concrete pier entirely free from the building, in order that no vibrations may be transmitted to the telescope.

"I believe the unit can be termed an amateur job, despite the fact that I did not actually lay the bricks, mix the concrete, or pour the iron castings for the mounting. I did design it all, also made the patterns, supervised the masonry, and did the rest of the construction.

"The mounting contains a temporary 8″ mirror made by Father A. Rivard, S.S.E., of St. Michaels College, but a 12″ mirror is being made."

The rugged proportions of Holcomb's mounting design are worth close study. This telescope will not shiver, as many do, when a fly alights on it. A telescope magnifies its own vibrations just in the measure that it magnifies the stars, hence vibrations that remain wholly invisible to the direct look cause the stars to dance wildly to the look through the telescope. This is why ordinary criteria for rigidity in machines, supports, and so on, are much too weak for telescope mounting design. A telescope should be theoretically about as rigid and rugged as a cubic yard of cast iron. Holcomb's is.

FIFTH in a long line of eight Newtonians ranging from 4″ to 12½″, and from *f*/5 to *f*/10, and built over a period of four years, is shown in Figure 4, with its maker and owner, John J. Stoy, 450 Hurt Building, Atlanta, Ga. In his letter Stoy styles himself "Director of the Smoky Hollow Freshair Observatory." The telescope is a 12½″ of *f*/8, and the total weight of telescope and pier is 3350 pounds. The design is conventional but unusually clean. "The polar axis counterweight," Stoy writes, "is open to argument as to necessity, but it brings the center of mass to the center of the pier." This last idea seems excellent, and in keeping with principles of mounting design stated by Porter in the treatise "Amateur Telescope Making," fourth edition.

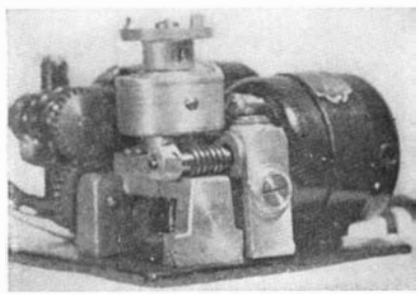


Figure 2: **The electric drive**

Close inspection of the figure will reveal a very smooth, clean declination axis casting and union for tube attachment. These were cast in iron, from patterns made and donated by Fred Ferson, Biloxi, Miss., author of the chapter on molding and casting, in "ATMA," and a friend of Stoy's. The upper end of the tube rotates. The tube is ventilated through an oversized cell with 9-point suspension.

How well your scribe recalls the day when Stoy received and began working the 12½″ Pyrex disk for this telescope, which, it seems, was just a bit bubbly! Daily thereafter the mails brought generous samples of the most competent old-fashioned southern cussin', but finally Stoy learned to defeat the bubbles and the profanity imperceptibly dwindled until, at last, he actually came around almost to loving Pyrex. Even now, however, you must smile when you say "bubbles" within his hearing. (It is impossible to cast Pyrex disks without some bubbles—can't get it hot enough and fluid enough, because of its high melting point, for all the bubbles to rise—but the makers throw out the poorer disks.) Stoy also refigured his mirror twice after most workers would have called it a day—we suspect merely in order to demonstrate to that — — — hunk of glass that he, and not it, was boss. And then, becoming finally softened and sentimental, he named the telescope "Bessie."

THE following communication is from James G. Baker, of the Harvard College Observatory:

"In reading through the very interesting article by Hendrix and Christie in the August Scientific American the present writer has noticed some incompleteness that might cause ambitious amateurs a bit of grief. All the various types presented by the authors are certainly workable, but caution must be exercised in order that cameras constructed should not exceed in aperture that which is justifiable theoretically.

"The thick mirror type discussed (Figure 3, IX in the August article) is optically inferior to both the ordinary and the solid kinds of Schmidt camera, although still quite a good camera in itself. The authors have failed to point out that the position of the apparent center on the axis depends upon the angle that the incoming rays make with the optical axis, and that this type of camera does not possess the symmetry of the Schmidt arrangement. Just as in the case of the usual Schmidt the third order errors are zero, which fact insures good performance, but, optically speaking, the thick mirror is not aplanatic beyond the third order, whereas the Schmidt is aplanatic to all orders of accuracy. The practical effect of this lack of perfection is to limit the speed and usable field of the camera, as compared with the Schmidt in glass. By a suitable deformation of spherical mirror and intermediate refracting surface, one can obtain nearly Schmidt performance, but the required optical work is more involved. The Zeiss company has recently produced a thick mirror system involving only spherical surfaces that has a flat field. The authors of the August article have neglected to point out that, as in the case of the usual Schmidt, the thick mirror type has a curved focal surface, spherical and concentric with the spherical mirror

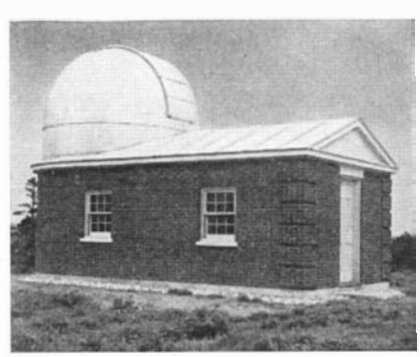


Figure 3: **Observatory, St. Michaels**

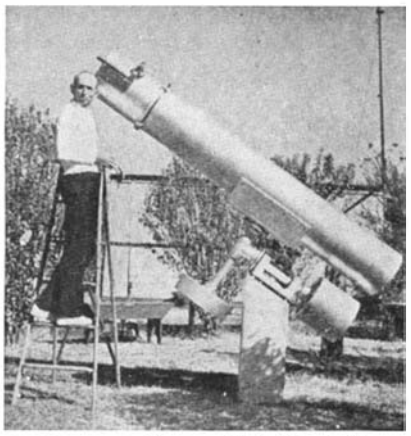


Figure 4: Stoy and his "Bessie"

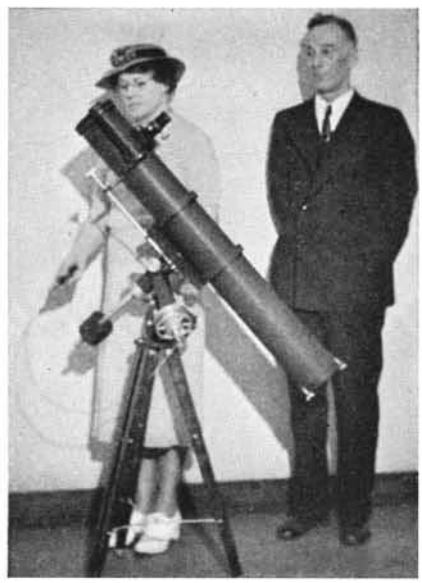
face and should be made so. The authors state on page 119 that the speed of an $f/0.66$ camera can be obtained with the field and correction plate curvature of an $f/1$ of the usual kind, but this is not correct. The depth of the correcting surface is exactly n times deeper, zone for zone, than for the usual Schmidt of the same physical size, and the usable field about n times larger, angularly, in the case of the solid Schmidt, and about the same in the case of the thick mirror system, all compared with the usual Schmidt. The letter n used above stands for the index of refraction of the glass of the thick mirror. The index of refraction that appears in the denominator of the expressions for the correcting surface will be that for the glass of the correcting plate, in the above thick mirror system.

"The performance of the Schmidt in glass is truly remarkable. The solid glass combination was discovered independently and was investigated through its fifth order image errors in May, 1938, by the present writer, and discussed at the October, 1938, meeting of the Optical Society of America. The solid Schmidt, I have heard indirectly from Bergedorf [Bergedorf Observatory, in Germany, where Schmidt worked.—Ed.] workers, was contemplated by Schmidt himself, some years ago. Sinclair Smith seems to have been the successor to Schmidt in coming upon the solid Schmidt, but the publication was delayed by his untimely death in May, 1938. The Bergedorf workers unfortunately concluded that the thick mirror type constitutes the only practical way of getting to the focal surface, as Hendrix did also in the early stages of his work. Hendrix, however, has now provided an ingenious solution in the form of the folded type. An off-axis type provides another.

"Let us compare the solid Schmidt with the ordinary Schmidt of the same physical size, that is, with the same aperture and radius of the mirror surface. The focal length is $1/n$ that of the usual Schmidt, the speed n^2 greater, the depth of the correcting surface n times deeper, the size of the chromatic aberration disk n times smaller at each wavelength, and the curvature of the field the same. The third order astigmatism, re-introduced by the central hump in the correcting plate, is slightly smaller than that for the usual Schmidt, and for both is numerically of the fifth order. The first error of importance in either the solid or the ordinary Schmidt is the variation of spherical aberration with angle. This defect is several times smaller for the solid Schmidt than for the usual kind. The variations of third order defects with color

THE BEGINNER'S CORNER

IF you are tempted to jump from your first 6" telescope making job to a much larger size, the accompanying photographs and description by a worker who jumped



the other way and put his energies into refinement may be worth considering. It is a 4" made by L. J. Ashby, 437 Stone St., Kalamazoo, Mich., and by Mrs. Ashby, and is equal in both design and finish to professional work. Both, we say, since we have seen a few telescopes with very exquisite or even over-elaborated finish but poor design. Ashby, who has been a telescope maker for several years, writes:

"There are a few who want a really portable instrument—one which does not require several strong backs and a truck to handle and transport. My wife cannot conveniently carry around even a 6", hence this 4" Newtonian which carries easily in the family car and can be handled by a woman. Some details are: Mirror made by Mrs. Ashby, with much oral but no manual assistance on my part. No scratches. Tripod, wood. Setting circles, graduated 5 minutes and 2°. Slow motions in both directions—in R.A. by flexible shaft. Tube, aluminum, cork lined for better temperature performance. Rack and pinion focusing. Level and compass for quickly alining polar axis. Finder, diagonal type, 7X, 5° field. Eyepieces, 1", ½", ¼" (after Clarke, in 'ATMA.'). Field of view with 1" eyepiece, 1½°. Tube wt.,

11½ lbs., mount and counterweight, 27 lbs. Cost, $35. Time, 210 hours.

"This little telescope resolves components of Epsilon Lyrae with ½" eyepiece, Pi Aquilae with ¼"."

After all, no beginner on his maiden telescope should attempt so fine a job as the Ashbys' but should aim to equal its design for rigidity, especially at two vital places: on the declination axis near the tube, where a large cross-section is here seen, and in the plate between this axis and the tube, which is here amply thick.

A little telescope, but built like a watch.

ANOTHER TN (which stands for Telescope Gnut, socially correct designation for telescope makers,) who, after making the beginner's 6", did not scorn to drop to a 4" because of its portability, is G. F. Hofferberth, R. F. D. 3, Dayton, Ohio, a telescope maker of long standing and now owner of a 12" Cassegrainian. It has a tube of copper sheet which was rolled, the edges scarfed and silver-soldered. The finish ("engine finish") was done on a drill press with a rubber grommet, oil and emery. Hofferberth made the patterns and did the machining for the polar axis support and bearing and for the well-proportioned fork, but the very beginner—the absolute tyro—need not worry about such refinements as the latter, since easier methods are available.

TELESCOPTICS

(*Continued from preceding page*)

are all zero with exception of spherical aberration, as in the case of the usual Schmidt. The front surface of the solid Schmidt behaves as a single prism face, so that, for large field angles, a star photographs as a very short spectrum. This defect is of no importance in spectroscopy, for which such a glass camera is most useful. The Harvard Observatory has under construction a solid off-axis Schmidt, for which the focal ratio has been pushed to the extreme of *f*/0.30. The focal length is 15mm, and the usable field 3mm linearly, or about 11 degrees. The field is still larger for reduced aperture.

"A variation of the Schmidt in glass is offered by converting the spherical mirror into a spherical lens surface, with a corresponding change in the depth of the correcting surface. Because of the small power of a lens surface of the same radius as a mirror surface, as compared with that mirror, the aperture-ratio of this type camera is limited to *f*/1.5 or slower. It is, nevertheless, a true Schmidt camera. The focal surface is spherical and concentric with the lens surface.

"In the article by Hendrix and Christie, even for the folded type, they mention a plane focal surface, and count it among the seven plane surfaces to be made. This is inaccurate, for the focal surface, as in the usual Schmidt, is spherical and concentric with the mirror, and should be made so.

"In the discussion of the Wright type, which has a flat field, the authors state that their *f*/1 was unsatisfactory because of higher order aberrations. This is not alto-

getter the complete story. The Wright type, in addition to having double the chromatic trouble of the Schmidt of the same focal length and aperture, has astigmatism of the third order, that seriously limits the field at high apertures. As the authors state, cameras of *f*/3 and *f*/4 are satisfactory for limited fields, but then there is no need to make one in glass. For spectrographic purposes, the Wright type, called specifically the "short" type to distinguish it as one of a family presented by Wright, also has a curved field, and on that surface third order astigmatism along the spectrum is zero.

"The present writer would like to caution the amateur, who is contemplating a very fast camera, to compute his correcting surface from the more accurate formulas given by Wright in 'ATMA,' and to try contacting some person who has made a Schmidt to check the computation. If the amateur makes a solid Schmidt, he should use the ordinary formulas for a correcting surface, but with a factor of n, the index of refraction, throughout, so that the correcting plate is n times deeper, zone for zone, than is the case for the usual Schmidt. Moreover, the position of the focal surface must be carefully computed.

"Hendrix and Christie mention that the easiest form of correcting plate to make is one for which center and edge are at the same height; that certainly must be correct from their wealth of experience and practice, but I would like to point out that the departure from the nearest sphere (one through center and edge) is nearly independent of their parameter k and, therefore, that the amount of aspherical figuring is likewise nearly independent of k.

"The above is in friendly criticism, with an eye toward aid to the amateur, and in no way should detract from the excellence and usefulness of the article as a whole."

In his letter of transmittal, Baker states that he has the entire set of quantitative formulas that bear on the Hendrix and Christie designs and will be willing to cooperate with any amateur desiring information, who is really serious about making some of these telescopes. In each case, he states, the many factors should be carefully balanced before the maker starts precipitously on a part not justifiable theoretically. He will give information to anyone wishing to know about the performance of a Schmidt of given specifications, or will recommend specifications to fit a given need. He has also designed a family of flat-field cameras, equivalent in performance to the Schmidt camera, which he described before the American Astronomical Society last summer.

Priority on (1) the fact that the correcting lens of a Schmidt should be made larger than needed and masked out, to facilitate the work, (2) the use of a liquid on the correcting lens while it is ground to shape, also use of a pattern of straight lines at the plate holder, and (3) the interpretation of the zones by the method just described, all described in the Hendrix and Christie article of last August, is claimed by Arthur De Vany, 727 Sylvan Court, Davenport, Iowa. In letters offered this department for publication long ago, De Vany described these methods. Owing to your scribe's procrastination in publishing them they were offered to *Popular Astronomy*, which published them a year or so ago, and it is now desired to mention the matter in order as far as possible to make amends.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

MEN WANTED, by Paul Garrett, is a 20-page illustrated pamphlet written by the Director of Public Relations of General Motors Corporation. It is essentially a plea, addressed to thinking people, for restoration of individual initiative—and its subsequent reward—as a means of substituting the cry of "Men Wanted" for that of "Jobs Wanted." *General Motors Corporation, Broadway at 57th Street, New York City.—Gratis.*

RUBBER INDUSTRY OF THE UNITED STATES covers 100 years of the rubber industry in the United States and presents the largest list of rubber products ever published. It includes a brief history of rubber, the discovery of vulcanization, something of the life of Charles Goodyear, and statistical details of the rubber manufacturing industry in the United States. *Superintendent of Documents, Government Printing Office, Washington, D. C.—10 cents (coin).*

SMALL APPLIANCES is a 32-page pocket-size booklet that describes and illustrates gas-operated equipment suitable for schools, laboratories, home work shops, and so on. It also contains a number of conversion charts which will be helpful to anyone considering the use of gas for any industrial or shop purpose. *American Gas Furnace Company, Elizabeth, New Jersey.—Gratis.*

ADVENTURES IN CONVERSATION is a 24-page illustrated booklet that deals with the art of conversation and the stimulating effect which it can have on every-day life. A good conversationalist can turn a dull subject into one that sparkles, can talk interestingly with conviction, can develop a personality which otherwise might be warped. The pathway to developing the art of conversation is found in this booklet. *Conversation Institute, 3601 Michigan Boulevard, Chicago, Illinois.—Gratis.*

CHEMICALS BY GLYCO is a comprehensive catalog of specialty chemicals including emulsifying agents, glycol and glyceryl esters, synthetic waxes, synthetic resins, plasticizers and flexibilizers. Included are a group of formulas and useful tables as well as a complete index of materials classified according to industry. *Glyco Products Company, Incorporated, 148 Lafayette Street, New York, New York.—Gratis.*

BETTER OUTLINES FOR YOUR HOME MOVIES is a 15-page booklet describing the Effectograph and its various uses in getting special effects in amateur movie-making. *Besbee Products Corp., Trenton, New Jersey.—Gratis.*

THIS PROBLEM OF FOOD, by Jennie I. Rowntree, is a 32-page illustrated pamphlet which discusses the basic principles of diet with comparisons of dietetic habits of Americans and other peoples. It shows particularly the effect on nutrition of inefficiencies in diet choice. An encouraging conclusion drawn from this booklet is that "a good diet does not mean eating things we don't like." *The Public Affairs Committee, 30 Rockefeller Plaza, New York, New York.—10 cents.*

PROGRESS THROUGH CO-OPERATION, by Edward R. Weidlein, is a four-page folder that outlines briefly yet succinctly the history and development of laminated safety glass. It tells also of the coördinated industrial effort which has made possible the high-quality safety glass of today. *Mellon Institute, Pittsburgh, Pennsylvania.—Gratis.*

MULTISTORY OR SINGLE STORY—WHICH? is an eight-page illustrated pamphlet which gives a graphic comparison of relative building and operating costs in single story and multistory industrial buildings. Because of the wide-spread interest in air-conditioning and other controls for industrial plants, this booklet devotes special consideration to the adaptability of various buildings to such installations. *The Austin Company, Cleveland, Ohio.—Gratis.*

ASPHALT POCKET REFERENCE FOR HIGHWAY ENGINEERS, by Prevost Hubbard and Bernard E. Gray, is a 237-page illustrated book, cloth bound, which is essentially a pocket manual of practical and authentic information about asphalt. This material, properly applied, can be used for such diversified surfacing operations as on tennis courts, sidewalks, playgrounds, airports, bridge floors, and river revetments. The book includes standard material tests, descriptions of paving equipment, and sections on nomenclature. It is prepared for the practical engineer. *The Asphalt Institute, 801 Second Avenue, New York, New York.—30 cents.*

SOUNDMIROR is a four-page folder which describes briefly a magnetic recording system that has many industrial and educational applications. This system operates by magnetically impressing a sound pattern on a steel tape, after which the sound can be reproduced any number of times. The pamphlet illustrates some of the mechanism used. *Acoustic Consultants, Incorporated, 1270 Sixth Avenue, New York, New York. —Gratis.*

PROGRESSIVE PATERSON is a 16-page thoroughly illustrated pamphlet designed to boost Paterson, New Jersey, as an industrial center. It tells the advantages which are offered there, of the home life of industrial workers, and gives information of interest to plant managers regarding such matters as transportation, available power, and so on. *The Industrial Commission, City Hall, Paterson, New Jersey.—Gratis.*

EASTMAN PHOTOGRAPHIC PAPERS is a 48-page booklet offering full information on photographic papers, and dealing at length with their photographic and physical characteristics. A section on "Printing for Quality" is of particular value, and gives helpful suggestions from the choice of paper to the finished print. A number of formulas are included in the section on toning. *Eastman Kodak Company, Rochester, New York.—15 cents.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Patent Changes

THE changes made in the Patent Law during the last session of Congress were designed primarily to shorten the period between the completion of an invention and the issuance of a patent covering the invention. The most important change in the law relates to the very important two-year period. Heretofore a patent application could be filed within two years of the first publication of an invention or within two years after an article embodying the invention was placed on sale or went into public use. Under the amendment to the law the period of two years is reduced to one year after August 5, 1940.

Another amendment which is corollary to the above amendment and which goes into effect on the same date relates to the practice of copying claims from issued patents for interference purposes. Heretofore a person claiming to be the inventor of certain subject matter covered by an issued patent could copy the claims of the issued patent within two years of the date thereof. This period has now been reduced to one year.

Another important change, which became effective on October 5, 1939, relates to the simplification of interference practice. An interference is a proceeding before the Patent Office between two or more claimants for patents on the same subject matter to determine which claimant is the prior inventor. Interference proceedings are necessarily involved and frequently consume a great deal of time through no fault of the Patent Office, with the result that the issuance of the patents involved is delayed. Prior to the change in the law, interference proceedings were heard in the first instance by an Examiner of Interference. An appeal could be taken from his decision to the Board of Appeals of the Patent Office and an appeal could be taken from the decision of the Board of Appeals to the Court of Customs and Patent Appeals or in the alternative a suit in equity could be filed to compel the issuance of a patent. The intermediate appeal to the Board of Appeals has now been eliminated and the interference is heard in the first instance by a board of three Examiners of Interference rather than a single Examiner of Interferences.

A fourth amendment to the law empowers the Commissioner to require a responsive amendment to be filed in connection with pending patent applications in a shorter time than the six months previously allowed by the law but under no circumstances in less than thirty days.

A fifth amendment abolishes so-called renewal applications. Heretofore upon the allowance of a patent application the applicant had six months within which to pay the final government fee. If he failed to pay the fee within that period the application became forfeited subject to being renewed in an additional six months period upon the payment of another government fee. The original intention of the renewal provision of the Patent Law was to permit a poor inventor who could not afford to pay the final government fee an additional period of time within which to obtain the necessary funds. However, it has frequently been charged that the renewal provision of the statute was utilized by wealthy companies and individuals to delay the issuance of a patent and thereby prolong the effective period of the monopoly. The renewal provision has now been abolished and the Commissioner of Patents now has the discretion to receive the final government fee if paid within one year after the expiration of the six months period allowed for the payment thereof.

The sixth amendment to the patent law is intended to increase procedural efficiency and provides for transferring jurisdiction over the registration of copyrights on commercial prints and labels from the Commissioner of Patents to the Register of Copyrights. The provisions of this amendment become effective on July 1, 1940.

Aluminum

FROM time to time rumors have been circulated as to the injurious effects resulting from the use of aluminum cooking utensils. It is interesting to note that the Federal Trade Commission has taken cognizance of these rumors and has filed a complaint against the publisher of pamphlets dealing with this subject, charging that the representations contained in the pamphlet deceive the public.

The titles of the pamphlets involved are "Poisons Formed by Aluminum Cooking Utensils" and "Are You Heading For The Last Round Up?" According to the Commission the pamphlets contained such statements as these—"A friend of mine, after having seventeen carbuncles, threw out his fancy aluminum ware. The carbuncles disappeared"; also "Another fed his dog from an aluminum dish; the dog died from cancer of the face."

Joint Ownership

THE weakness inherent in the joint ownership of a patent is illustrated by a recent suit for patent infringement. The suit was brought by the co-owners of a patent for a non-refillable drum for lubricating oil against a prominent oil refining company. The Court found that one of the co-owners of the patent had previously entered into a contract with the oil refining company wherein he had granted a license to the company to use the invention covered by the patent. The usual rule of law applicable in such cases is that a good and valid license may be granted by one of the co-owners of a patent and thereafter the licensee is not liable to pay damages or profits for patent infringement to the other co-owner.

In the case in question it was argued by the co-owners that a different situation existed because of a contract between the co-owners whereby each agreed not to dispose of his share in the invention without the written consent of the other. This agreement, it was contended, rendered it impossible for either of the co-owners to grant a license without the consent of the other. The Court concluded that while the agreement was no doubt binding between the parties it was not binding on the oil refining company in the absence of notice of the agreement. The Court found that as a matter of fact the oil refining company did not have such notice and that accordingly it was licensed to practice the invention covered by the patent.

Gold Medal

THE Commissioner of Patents has ruled that the words "Gold Medal" are not descriptive of various items of merchandise or of their characteristics or qualities.

This rule was handed down in connection with the application for the registration of the words "Eventually Gold Medal" as a trade mark for poultry, dog, and cat food. The Examiner rejected the application on the grounds that the words "Gold Medal" were "descriptive of various items of merchandise that have competed successfully in expositions or contests and awarded gold medals."

An appeal was taken to the Commissioner of Patents who reversed the decision of the Examiner, holding that the words "Gold Medal" were merely suggestive of the characteristics of the merchandise and not descriptive thereof.

Foreign Commerce

THE Federal Trade Commission has recently shown an interest in unfair methods of competition in foreign commerce. Thus, it has issued a complaint against an importing and exporting company charging that the company had induced a Japanese manufacturer to misbrand Japanese-made optical lenses and falsely to mark them "Made in U. S. A." The company is also charged with procuring foreign business by "negotiating the export of such falsely branded products to Cuban importers."

The Commission alleges that purchasers in certain foreign countries, including Cuba, have a preference for products made in the United States as distinguished from like products made in Japan, and that these countries grant reductions in import and custom duties on products made in and imported from the United States. Under the circumstances the Commission charges that the company's practices are unfair and react to the prejudice of competitors and to the prejudice and injury of United States manufacturers of optical lenses.

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"Look, Pop! It's a Homer!"

Not last week's game; not something that happened yesterday; not even a minute ago. But *right now!* Seeing things — miles away — at the very instant they happen! That's the new thrill that television now makes possible.

BUT television is destined to do more than this for us. The foundation is laid for a whole new industry—careers for artists; jobs for hundreds of engineers and thousands of skilled workmen making television transmitters and receivers; jobs for thousands more selling and servicing this new product and providing the raw materials required. These are important possibilities of television.

For more than 60 years, General Electric scientists, engineers, and workmen have been finding new ways for electricity to serve the public — in factory, farm, and home. The new products and services made possible by their work have helped to produce the steady rise in the living standards of the American people.

And *right now,* as television emerges from the laboratory to take its place among the accomplished marvels of this age of electricity, these G-E pioneers are once again creating, not only "More Goods for More People at Less Cost," but also MORE AND BETTER JOBS AT HIGHER WAGES.

G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric

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