elementary courses, the proper view of knowledge and an understanding of the means by which it grows. Nothing would probably go farther toward bringing us to a satisfactory view of our present situation than a course of instruction on that which we do not know, but which might by investigation become known. With this there should go a presentation of evidence as to the methods by which constructive work could bring this information and apply it.

A great responsibility for realization of the possibilities in education rests upon those scientific organizations which have given themselves especially to the problems of constructive thought. Through the scientific institutions which we represent, it is our duty to make clear the function of education to train in judgment and construction rather than to encourage merely the amassing of facts. A responsibility rests upon us to see also that the results of our own investigations are not buried more deeply than were the materials upon which they have been based. New ideas should be clearly recognized, fully stated, and placed where the applying engineer may find the data which he requires to meet human needs. We have again a duty, so to organize our work that other investigators and applyers may not only know the results, but that they may cooperate with us to mutual benefit.

There is no doubt that properly organized and coordinated efforts of science and education may increase greatly the present opportunity of the average man for constructive activity, making his life more useful and happier. The average man of the future will of necessity live his life largely in a routine based upon customs of the prevailing social order. He will give himself to action governed by established rules formulated from experience; but always and increasingly in his individual affairs, as in his relation to the community, he will find his largest measure of satisfaction in the building type of effort originating through his own thinking. As the product of the life work of each individual accumulates, the evidence of true individuality will become more clear, until there emerges from the chrysalis stage of mere physical and mental separateness the newborn personality of one who in creating an idea has given to himself the right of eternal individual recognition as an intentional participant in human progress.

As the problems of community organization become more clearly visualized, the importance of the research or constructive spirit in the average man will increase, and the future of democracy depends in a measure upon the possibility of securing for each capable person an opportunity to obtain the wider view of the greater problems, to learn dependence upon those who know and are true, and with all this to make contribution in an unselfish spirit. Unless these objects are realized we are doomed to revolve without progress through endless cycles of misunderstanding and conflict.

Education with its varying emphasis on the fundamental truths of science, philosophy, human relations and religion is our principal safeguard. Our definite guarantees of progress are found in the lessons of history, taken with the present wide expression of individual responsibility for judgment in the critical affairs of citizenship.

John C. Merriam

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES IN 1920

A compilation of the doctorates conferred by American universities has been made for each year from 1898 to 1916, and the data published in Science annually through 1915 and in *School and Society* for 1916. Dr. Burg, who compiled the last annual statistics, severed his university connection in 1917 and the compilation was turned over to someone else who for various reasons was unable to complete the work. No statistics, therefore, are available for 1917–18 and 1918–19, but the compilation has been resumed for the academic year 1919–20 in so far as the doctorates conferred in the sciences are con-

cerned, and the comparison with previous years indicates that conditions affecting doctorates have regained a normal state. There has been no increase in the number conferred, nor any considerable decrease.

In 1920 there were 328 doctorates conferred in the natural and physical sciences by 31 institutions. In 1916 there were 332 conferred by 28 institutions. It is interesting to note that the small decrease in the number of degrees conferred is practically equalled by the small increase in institutions conferring them. Those institutions which have always been at the head of the list have changed their order in some cases, but are still leading. However, the degrees seem to be more widely distributed than formerly. The University of Chicago continues to confer the largest number of degrees, while Cornell University takes second place. As usual, the eastern universities lead in numbers conferred, though the western and middle western institutions follow very closely with only 14 less. Johns Hopkins University dropped from 23 in 1915 and 22 in 1916 to 17 in 1920, and Harvard rose from 16 in 1916 to 28 in 1920. Wisconsin and Illinois have taken their places in the first group, with 24 and 22 degrees respectively. There were 14 universities conferring degrees in the past which conferred none this year.

Chemistry continues to head the list of subjects in which the doctorates were conferred, though with not so large a number as in 1916, nor so great a per cent. of the total. In 1916 there were 115 conferred in chemistry and in 1920 there were 96. Small gains in many of the other sciences bring up the total. The most noticeable gain is in psychology, which has risen from 22 in 1915, and 19 in 1916 to 40 in 1920. No doctorates were conferred specifically in paleontology, mineralogy, metallurgy or meteorology.

A list of the names of the recipients of the doctorates with the titles (sometimes abridged) of their theses has been made, classified by the subject in which the degree was conferred, and grouped under the subject according to the university conferring them.

DOCTORATES CONFERRED IN THE SCIENCES IN AMERICAN UNIVERSITIES

	'12	'13	'14	'15	'16	'20
Chicago	37	16	28	53	53	59
Cornell	28	30	36	26	24	35
Harvard	15	22	28	33	16	28
Columbia	36	27	21	27	34	24
Wisconsin	14	5	17	8	22	24
Yale	21	19	13	20	24	23
Illinois	15	11	18	17	26	22
Johns Hopkins	23	21	18	23	22	17
California	12	9	11	16	17	14
George Washington	2	1	2	4	5	9
Michigan	8	10	5	15	10	9
Princeton	7	7	7	4	19	9
Ohio	5	0	0	1	2	6
Indiana	4	1	2	4	3	5
Iowa	3	2	2	2	2	5
Mass. Tech.	6	1	2	2	3	5
Pennsylvania	9	9	5	11	16	5
Clark	6	13	7	10	9	4
Minnesota	2	2	3	4	7	4
Stanford	3	5	2	2	0	4
Brown	4	1	4	5	2	2
Cincinnati	1	2	2	0	2	2
Missouri	0	1	1	1	3	2
Pittsburgh	1	5	0	4	0	2
New York	2	3	1	3	0	2
Syracuse	0	0	0	0	0	2
Bryn Mawr	3	0	2	0	3	1
Catholic	1	0	0	2	1	1
Kansas	0	0	0	0	0	1
Radcliffe	0	0	0	0	0	1
Virginia	2	2	1	0	2	1
Total	273	234	241	309	332	328

DOCTORATES DISTRIBUTED ACCORDING TO SUBJECTS

	'12	'13	'14	'15	'16	'20
Chemistry	78	68	71	85	115	96
Botany	30	28	34	40	36	47
Psychology	29	24	12	22	19	40
Zoology	20	26	25	32	33	38
Mathematics	22	21	25	23	34	20
Physics	30	22	23	31	35	20
Geology	23	14	13	26	17	16
Physiology	12	2	8	8	14	14
Agriculture	11	8	9	9	6	8
Bacteriology	6	3	6	4	4	7
Astronomy	2	11	2	7	6	6
Engineering	2	0	4	2	2	5
Anatomy	6	1	2	5	1	3
Geography	0	1	0	3	3	3
Pathology	2	2	1	2	2	3
Anthropology	0	3	2	6	1	2
Paleontology	0	0	4	2	3	0
Mineralogy	0	0	0	1	0	0
Metallurgy	0	0	0	1	1	0
Total	273	234	241	309	332	328

THESES DISTRIBUTED ACCORDING TO SUBJECT

Agriculture

CORNELL: Roy Glen Wiggans, "Classification of the cultivated varieties of barley." Daniel Scott Fox, "Analysis of the cost of growing potatoes." Frank App, "Farm profits on 370 potato farms in Monmouth, New Jersey."

ILLINOIS: Jose Jison Miralsol, "Aluminum as a factor in soil acidity."

MINNESOTA: Paul Harmer, "Uniformity of the Late Gray Drift of Minnesota."

WISCONSIN: William Merriott Gibbs, "Isolation and study of nitrifying bacteria." Tsunao Inomata, "Intensity of culture." Frederick Charles Bauer, I. "Effect of leaching on the availability of rock phosphate to corn." II. "Relation of organic matter and the feeding power of plants to the utilization of rock phosphate."

Anatomy

CHICAGO: Luther Sherman Ross, "Cytology of the large nerve cell of the crayfish (*Cambarus*)."

CORNELL: Lyda May Degener, "Development of dentary bone and teeth in the lower jaw of *Amia calva*."

HARVARD: Ralph Faust Shaner, "A study in comparative embryology."

Anthropology

COLUMBIA: Leslie Spier, "The Sun Dance of the Plains Indians."

HARVARD: Edward Smith Handy, 3d, "Polynesian religion."

Astronomy

CALIFORNIA: Sophie Hazel Levy, "Theory of motion of the planet (175) Andromache." Charles Donald Shane, "The spectra of certain class N stars."

CHICAGO: Alice Hall Farnsworth, "Comparison of the photometric fields of the 6-inch doublet, 24-inch reflector, and 40-inch refractor with some investigation of the astrometric field of the reflector." Hannah Steele Pettit, "Proper motions and parallaxes of 359 stars in the cluster *h* Persei." Edison Pettit, "Form and motions of the solar prominences."

MICHIGAN: Julia May Hawkes, "Photographic determination of the positions of stars and nebulous knote in and around the great nebula of Andromeda."

Bacteriology

CALIFORNIA: Theodore Day Beckwith, "Studies upon the chemotherapy of the experimental typhoid carrier condition."

CHICAGO: Ida Albertina Bengtson, "The proteus group of organisms." Benjamin Junior Clawson, "Varieties of streptococci with special reference to constancy."

HARVARD: Monroe Jacob Schlesinger, "The mechanism of antianaphylaxis."

NEW YORK: Hassow Otto Von Wedal, "Complement fixation test for tuberculosis."

OHIO STATE: Edward Everett Hale Boyer, "The chemical nature of the antigenic substances in Bacillus coli."

YALE: William Shelton Sturges, Jr., "Bacterial autolysis."

Botany

BROWN: Eda May Round, "Carboniferous flora of Rhode Island."

CALIFORNIA: Carl Hartley, "Damping-off in forest nurseries."

CHICAGO: Arthur Wing Haupt, "The life-history of *Fossombronia cristula*." Ladema Mary Langdon, "Stem anatomy of *Dioon spinulosum*." John James Willaman, "Function of vitamine in the metabolism of *Sclerotinia cinerea*." Dean Alvin Pack, "After-ripening and germination of juniper seeds." Scott Verne Eaton, "Sulfur content of soils and its relation to plant nutrition." Hope Sherman, "The respiration of dormant seeds." Perry Daniel Strausbaugh, "Study of dormancy in the plum." Helen Ashhurst Choate, "Study of certain chemical changes occurring in wheat during germination." Howard DeForrest, "Plant ecology of the Rock River Woodlands of Ogle County, Illinois."

COLUMBIA: Frederick Vernon Rand, "The chloratic groups of plant diseases with special reference to pecan rosette." Robert Aaron Stemberg, "Stimulation of growth by zinc and ferric sulphates." Harvey Earl Thomas, "Relation of the health of the host and other factors to infection of *Opium graveolens* by *Septearia apiirosti*."

CORNELL: William Henry Eyster, "Linkage relations of the factors for tunicate ear and starchy-sugary endosperm in maize." Ernest Gustaf Anderson, "Inheritance of salmon silk color in maize." Vining Campbell Dunlap, "Studies of development in the genus *Pleurotus*." Edwin Fraser Hopkins, "The botrytis blight of tulips." Harry E. Knowlton, "Studies in pollen." Roy David Anthony, "Sexual inheritance in the violet." Harvey Elmer Stork, "Biology, morphology and cytoplasmic structure of *Aleu-*

rodiscus.'' Harry Wilmer Dye, ''The bottom-rot and the stunt.'' Gordon Peter McRostie, ''Inheritance of disease resistance in the common bean.'' Frank Burkett Wann, ''Fixation of free nitrogen by green plants.''

GEORGE WASHINGTON: William Edwin Safford, ''Revision of the genus *Datura.*''

HARVARD: Oran Lee Raber, ''Effect of anions upon permeability.'' Alden True Speare, ''Morphology and reproduction of *Sorosporella uvella.*''

ILLINOIS: Lee Ellis Miles, ''Leaf spots of the elm.'' Mary Emma Renich, ''Growth as related to specific gravity and the size of seed.'' Edwin Rollin Spencer, ''Some of the causes of decay of Brazil nuts.'' Truman George Yuncker, ''Revision of the North American and West Indian species of *Cuscuta.*''

IOWA STATE: Beryl Taylor, ''Development of foliage leaves of *Vitus vulpina* L. and *Catalpa bignonoides* (Walt.).

JOHNS HOPKINS: William Ernest Seifriz, ''Structure and behavior of protoplasm as determined by the aid of microdissection.''

MICHIGAN: Ray Clarence Friesner, ''Daily rhythms of elongation and cell-division in certain roots.'' Frieda Cobb, ''Case of mendelian inheritance complicated by heterogametism and mutation in *Œnothera pratincola.*''

OHIO STATE: Swarna Kumer Mitra, ''Toxic and antagonistic effects of salts on *Saccharomyces ellipsoideus.*''

PENNSYLVANIA: William Randolph Taylor, ''Morphological and cytological study of reproduction in the genus *Acer.*'' Irwin Boeshore, ''Morphological continuity of Scrophulariaceæ and Orobanchaceæ.''

PITTSBURGH: Earnest Milton Gress, ''Grasses of Pennsylvania.''

RADCLIFFE: Matilda Moldenhauer Brooks, ''Quantitative studies on the respiration of *Bacillus subtilis* (Ehrenberg) Cohn.''

WISCONSIN: Clyde Melvin Woodworth, ''Inheritance studies in soy beans. I. Cotyledon, seed-coat, hilium, and pubescence colors.'' Bert Lorin Richards, Title of thesis not given. William Burley Tisdale, Title of thesis not given. Walter H. Snell, Title of thesis not given. Edward Eastman Clayton, ''Influence of certain environmental factors on the development of the fusarium wilt of tomatoes.'' Mabel Mary Brown, ''Distribution of sexual characters and regeneration in *Funaria hygrometrica* (L) Sibth.''

YALE: Julia Bayles Paton, ''Pollen and pollen enzymes.''

Chemistry

BROWN: Chester Lewis Knowles, ''Preparation of para dephenyl propiolic acid.''

CALIFORNIA: John Merritt McGee, ''Preparation and properties of sodium amide.'' Roy Frederick Newton, ''Equilibria in reactions of methyl alcohol with hydrochloric acid and with hydrobromic acid.'' George Sutton Parks, ''The specific heats of ethyl and propyl alcohols.''

CHICAGO: Ray Quincy Brewster, I. ''Symmetrical tetraprophylethane.'' II. ''Reduction of nitrotriphenylamine.'' Elvah Harley Grafton, ''The adsorption of benzene derivatives on the surface of water.'' Morris Selig Kharasch, ''Colors of the second order.'' George Elmer Miller. I. ''Preparation of pure cyanogen chloride. II. Preparation and study of d- and l-beta gamma diozybutyric acid.'' Charles H. Milligan, ''The preparation of d-l-P-methyl-isopropyl methyl-phenyl hydrazine. The isolation of pure d-P-methyl-isopropyl methyl-phenyl aniline.'' Henry John Rossbacher, ''M-tolyl-ethyl-barbituric acid.'' Karl Theodor Steik, ''The effect of alkali upon Portland cement.'' Roger John Williams, ''The vitamine requirement of yeast.'' Lathrop Emerson Roberts, ''A study of phase boundaries.'' Amando Clements, ''The relation between pore size and adsorption in charcoal.'' Mary Meda Rising, I. ''The preparation of phenylethylbarbituric acid. II. The preparation of para-ureido-phenylacetylurea and related compounds. III. An attempt to filter the enzymes of milk.'' John Edward Schott, I. ''Oxidation of benzamide. II. Derivatives of phenylethylbarbituric acid.'' Dwight Tarbell Ewing, I. ''The densities and adsorption and desorption properties of gas mask charcoals. II. The effects of acids and bases on the surface energy of B-B-dicolorethyl sulphide ('Mustard gas').'' Steward Basterfield, ''Derivatives of isourea and their pharmacological action.'' Ying Chang Cheng, ''Cohesion, adhesion, tensile strength, tensile energy, negative surface energy, interfacial tension, and molecular attraction.'' Frank Louis DeBeukelaer, ''Derivatives of phenylethylacetic acid and of phenyldiethylacetic acid.'' Warren Walter Ewing, ''Attractions of mercury for other liquid.'' Louis Melvin Larsen, I. ''Nitrotriphenylamines. II. Oxidation of diaminophenols.''

CINCINNATI: Clarence Alonza Mills, "Distribution, nature and method of action of tissue coagulants."

CLARK: Chung Yen Chiu, "Nature of the complexes formed between the alkali metals and certain heavy metals in liquid ammonia." Henry Cole Parker, "Conductance of iodic acid in aqueous solution."

COLUMBIA: Eliz Brakelly, "Factors affecting the stability of addition compounds in solution and their influence upon viscosity." Paul Maymes Gross, "Factors affecting the stability of addition compounds in solution and their influence on ionization-equilibria." Theodore Clinton Taylor, "Fat associated with starch." Marguerite Wayman, "The effect of certain antiseptics upon the activity of amylases." Francis J. Fuchs, "Effect of foreign oxides upon the decomposition of silica oxide, mercuric oxide and barium peroxide." Paul M. Giesy, "Chemical study of the placental harmone." Mary Louise Landon, "Formation of addition compounds between 100 per cent. sulphuric acid and the neutral sulphates of the alkali metals." Ida Pauline Rolf, "Contributions to the chemistry of the unsaturated phosphatids."

CORNELL: Frank William Douglas, "Chemistry of germanium." Ralph W. G. Wyckoff, "Crystal structures of cassium dichloroiodide and of sodium nitrate." Major Edward Holmes, "Contributions to the chemistry of the hydronitrogens and pernitrides."

GEORGE WASHINGTON: Elias Elvove, "The detection and estimation of small amounts of organic nitro compounds with special reference to the examination of the urine of TNT workers." Edward Elmer Smith, "The effects of bleaching with oxides of nitrogen upon the baking qualities and commercial value of wheat flour." Peter John Donk, "A thermophilic bacterium causing flat-sour in canned goods."

HARVARD: Edward Adelbert Doisy, "Determination of sodium, potassium and chlorine in small samples of tissue." Webster Newton Jones, I. "Study of 1, 2-dibenzoyl-3-phenylcyclopane. II. 1-Iod-2, 4, 6-tribrom-3-nitrobenzene. III. 2, 2, 3-trimethylpentane." Alexander Donald Macdonald, "Addition of phosphorus trichloride to saturated aldehydes and ketones." David Robert Merrill, I. "On catalytic oxidation. II. On certain cyclopropane derivatives."

ILLINOIS: Miner Manly Austin, "Potash in Illinois shales." Herbert Ephraim French, "Preparation of substituted alpha halogen benzyl benzoates, and a study of the reactions of these compounds." Ralph William Hufferd, "Application of Victor Meyer's esterification law to neighboring xylic acid and its reduced derivatives." Carl Shipp Marvel, "Study of the possible asymmetry of the aliphatic diazo compounds." Ruth Evelyn Merling, "Methods of arylaton." Sargent Gastman Powell, "Unsaturated phenyl ethers and their rearrangements." Lynne Herman Ulich, "Reactions between acid halides and aldehydes." William Alexander Van Winkle, "Study of the determination of the halogens in volatile organic compounds."

JOHNS HOPKINS: Frederick Keller Bell, "Effect of copper on the solubility of iron in acids." Charles Edward Lanning, "Study of an oxidizing catalyst." Edward Otis Holmes, Jr., "Action of ultra-violet light on gels." Frederick Collins Lee, "Electrolytic preparation of ammonium permanganate." Paul Lange Lotz, "Osmotic pressure of sucrose 30° and 55°.7 as determined by the water interferometer." George Edgar Miller, "Anthraquinone, 1, 8 aliphatic thioether-sulphonic acids and di-thioethers." Colin MacKenzie MacKall, "Anthraquinone 1, 5 aliphatic thioether-sulphonic acids and di-thio-ethers." Charles Snowden Poggott, "Catalytic oxidation of ammonia." Lloyd Hilton Reyerson, "Nature of the interfaces existing in the pores of silica gel and the retention of bromine by silica gels." Thomas Cobb Whitner, Jr., "Study of the reactions of normal butyl mercaptan and some of its derivatives."

MASSACHUSETTS: James Alexander Beattie, "Investigations in the electromotive forces of concentration cells of lithium and potassium chlorides." Ming Chow, "Investigations in the electromotive forces of concentration cells of potassium hydroxide, and on the activities of ions in mixed electrolytes." Yu Liang Yeh, "Investigations of liquid junction potentials, and on the activities of ions in mixed electrolytes." Charles Ernest Ruby, "Investigations of the equilibria and free energies of mixtures of manganate, permanaganate, and hydroxide of potassium and manganese dioxide."

MICHIGAN: Dorothy Hall, "Separation of copper and cobalt by phenythiohydantoic acid and the volumetric determination of cobalt." Earl Grover Sturdevant, "Electrodeposition of brass from cyanide solutions."

NEW YORK: Irene Caroliner Diner, "Microscopic examination of rubber and rubber products."

OHIO STATE: Frank Carl Vilbrandt, "Oxidation of

methane.'' Melvin Guy Mellon, ''Further study of a lead standard cell.''

PITTSBURGH: Emil Harold Balz, ''Derivatives of 2, 4, 6, trinitrobenzaldehyde.''

PRINCETON: Arthur Ferguson Benton, ''Gas flow meters and the end correction in the determination of gas viscosity by the capillary tube method.'' Homer Hiram Lowry, ''Studies in the absorption by charcoal.'' Merwyn Clarence Teague, ''Efficiency, testing and improvement of gas warfare box respirators.''

VIRGINIA: Judson Hall Robertson, ''Hydrolysis and heat of formation of urea sulphate, and the relation of these factors to the decomposition of urea into ammonia and carbon dioxide in aqueous solutions.''

WISCONSIN: George J. Ritter, ''Catalytic hydrogenation of cotton seed oil.'' Van Lorens Bohnson, ''Contribution to the study of the catalytic decomposition of hydrogen peroxide.'' Barnett Sure, Title of thesis not given. Wallace Headen Strowd, ''Studies in the nitrogen metabolism of the soy bean.'' Daniel Christopher Leander Sherk, ''Thymol and carvacrol problems in connection with the Monardas.'' George Robert Shaw, ''Chemistry of platinum at high temperatures and pressures.'' Clifford Shattuck Leonard, Title of thesis not given. Clinton B. Clevenger, I. ''The accurate determination of the hydrogen-ion concentration of plant juices by means of the hydrogen electrode. II. Factors affecting the acidity of hydrogen-ion concentration of plant juices.''

YALE: Charles Barkebus, ''Some constituents of *Viburnum Prunifolium* or Black Haw.'' Stuart Robert Brinkley, ''Equilibrium in the system ammonia-ammonium nitrate-ammonium thiocyanate.'' Florian Anton Cajori, ''Nutritive properties of nuts.'' John Joseph Donleavy, ''Alkylation of aromatic amines by interaction with aliphatic alcohols.'' Jacob Benjamin Fishman, ''New derivatives of benzylalcohol possessing possible therapeutic interests.'' Martha Richardson Jones, ''Studies on carbohydrate metabolism in rabbits.'' Frederick William Lane, ''Study of certain alkyl derivatives of resorcinol and their value as antiseptics.'' Walter Gerald Karr, ''Studies on nutrition.'' Icie Gertrude Macy, ''Comparative studies on the physiological value and toxicity of cotton seed and some of its products.'' Lyman Edwards Porter, ''Analytical chemistry of gallium.'' George Walter Pucher, ''Development of the intermediate stages of a new method of synthesizing histamine.'' Arthur Henry Smith, ''Effect of solutions of certain salts and colloids on the permeability of the capillary walls.''

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(*To be concluded*)

THE LOW TEMPERATURE LABORATORY OF THE BUREAU OF MINES

ON June 17, 1920, Professor J. C. McLennan, of the University of Toronto, gave a lecture before the Chemical Society in London, on "Helium, Its Production and Uses." This lecture has been printed in the July, 1920, number of the *Journal of the Chemical Society*. At the close of his lecture Professor McLennan gave special emphasis to the great need of a properly equipped cryogenic laboratory somewhere within the British empire. To quote his own words:

> The list of problems rendered capable of attack by the use of liquid helium might be easily extended, but those cited already will serve to show that the field is large and that it is well worth while for us to make a special effort to secure adequate financial support for the equipment and maintenance of a cryogenic laboratory within the Empire. It is probably beyond the ordinary resources of any university to equip and maintain such a laboratory, but the project is one which merits national and probably imperial support. It should appeal to private beneficence as well for it is a project deserving strong and sympathetic help.

It may be of interest to American scientists to know that the need of such a laboratory in this country was recognized by the Bureau of Mines more than a year ago. The immediate need was for the obtaining of certain scientific data which is necessary for the improvement and development of the commercial work in connection with the government helium plants, but there is a large field outside of this immediate need which can be covered by such a laboratory.

Through the interest and broadmindedness of Commander A. K. Atkins, of the Navy, and Colonel C. DeF. Chandler and Lieutenant R.