A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

For Private Circulation

LOYOLA COLLEGE
BALTIMORE, MARYLAND

VOL. X MARCH, 1933 NO. 3

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EASTERN STATES DIVISION

VOL. X MARCH 1933 No. 3

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EDITORIAL

Another chapter in the history of the world closed with the end of the year. In retrospect, the progress of the scientific world found new facts, expended much energy in its field of research, and increased our knowledge of the unknown in all the natural sciences. With all our previous knowledge and experience, advance is laborious and slow. However, a casual glance of the year's progress in science is impressive.

In the field of pure physics, among the more spectacular developments were the discovery of the neutron, the isolation of an isotope of hydrogen, progress involving the puzzle of the atom by various means, and the world-wide attack on the problem of the nature and origin of the cosmic rays.

The latter campaign enlisted the aid of a small army of scientists, who carried cosmic ray research to the top of the world's highest mountains, to the Northern and Southern Hemispheres, from the Equator to the Arctic Circle, and up into the stratosphere by balloon. Meanwhile, others in laboratories measured the intensity of the rays, attempted to determine their direction and made photographs of their activities with the aid of an ingenious device known as the "cloud chamber," and a powerful magnetic field.

The discovery of the neutron, though forecast earlier on theoretical grounds, let in a flood of new light on the nature of matter and the structure of the atom. This particle, presumably consisting of one proton and one electron bound closely together, represents the atom of a new element, which chemists have proposed calling "neuton." We may never see this element in the pure state, because the atoms of which it would be composed are so small and so heavy that no vessel would hold them; they would slip easily between the coarser atoms of glass or metal.

Advances in chemical fields included the discovery of a new anesthetic: divinyl oxide; the preparation of a synthetic quinine, said to be more effective than natural quinine and less bitter; perfection of a method for depositing tungsten electrically on other metals, thus adding to the growing list of corosion and wear-resisting materials available to industry; the successful manufacture of white paper from southern yellow pine, making available for this industry huge forests in the South that were formerly useless for paper; and adaption in this country for the hydrogenation process for synthetic manufacture of fuel and lubricating oil.

The photo electric cells and similar light and heat sensitive units have definitely moved out of the laboratory into the factory, automatically supervising intricate machinery with a speed and accuracy that would be impossible for a human workman. These cells now control continuous strip mills in steel manufacture, regulate the heat to which rods are subjected in automobile factories, control doors, elevators and smiliar apparatus, measure variations in electrical resistance, or movements so slight as to deceive the human eye.

A new apparatus based on the photo-electric cell controls artificial lighting by means of daylight. It includes a compensating device to tell the difference between artificial and natural light, and also has a time delay so that it will not mistake a cloud passing across the sun for twilight. Still another type of "electric eye" has been developed so sensitive that it can be operated on one ten-thousandth of a foot candle, that is, the amount of light given by a candle one hundred feet away.

The year also has seen widespread advances in the art of welding, a method of fabrication and repair which is destined to become increasingly important in industry owing to improved methods of welding various metals and alloys and of testing the finished welds for flaws and weakness. Related to improved welding practices is the increased use of hard-surfacing materials, especially alloys of chromium-iron-nickel, cobalt-chronium-tungsten and tungsten-carbide. These hard, wear-resisting combinations, welded to the bearing surfaces, and other wear points of machinery, have saved millions of dollars worth of machinery which otherwise would have been scrapped.

In the field of engineering, the outstanding notable projects are the completion of the diversion tunnels which carry the waters of the Colorado

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MIRADOR OBSERVATORY, BAGUIO PHILIPPINE ISLANDS

Mirador Observatory is one of the basic observatories which make up the network of observation stations of the Weather Bureau, with its centre of operations at the Manila Observatory, where coordination and computations are made from the data received.

The beneficial contributions of the Weather Bureau are many and famous. The weather forecasts, and especially the conspicuous well-known warning signals of impending typhoons and their relative magnitude have prevented otherwise large and serious losses of life and property throughout the Islands. Likewise the prevention of harm to travellers and sailors and damage to shipping in the surrounding waters for hundreds of miles, have made the official and accurate observations and information by the Jesuit Fathers there and in China world renowned.

Although these stations are owned and directed by Ours, they function as the only official Government Weather Bureau of the Philippine Islands.

Name—Mount Mirador (Mount Lookout) because of the magnificent view it affords even extending to the China Sea in the distance.

To a scientist it is a Meteorological—Geodynamic or Seismic Station of the Weather Bureau of the Philippine Islands. (Central Observatory—San Jose, Manila.)

Situation—Formerly on various lower levels of Baguio.

Established as a "First-Class" Observatory on present site, Mount Mirador, on July 1, 1909.

Comparative Heights—Burnham Green and City Hall: 4,740 feet above sea level.

Mount Mirador (Ranking among highest observatories in the world): 4,957 feet.

Mount Santo Tomas (Highest of the three outstanding peaks in the neighboring mountains): 7,425 feet.

Valley to West of Mirador: 500 feet below top of Mirador.

Extent of View—Distance to Provincial Coasts and mouth of the Aringuay River: 16 miles or 25.7 kilometers (over land).

Distance to horizon: 85 miles or 137 kilometers. (This view includes miles of the coasts of Pangasinan—The Bolinao Peninsula—and La Union, The Linguayan Gulf, and China Sea.)

Recording Instruments (in use in 1930)—Thermometres for observing temperature above, and temperature of the grass.

Richard Hygrometer: recording humidity of the air. Friez Quadruple Register (in office) electrically marking on paper a fourfold record automatically made by contact every minute with the following outdoor instruments:

A & B) The Richard Anemometer, measuring velocity of the wind and indicating the present one of eight possible directions of the wind.

C) Marvin Heliograph or Sunshine-recorder.

D) Pluviometer or Tipping-bucket Rain Gauge—electrically measuring amount of rain and speed of rainfall.

Barographs—mechanically recording the atmospheric pressure continually day and night.

Astral Cameras—For night photographing of stars, clouds by day.

Local Seismograph and Distant Microseismograph; (Space does not allow here an interesting explanation and history of these.)

Observatory Clocks—Official Philippine Time by telegraph from the central Observatory in Manila.

Also, Signal (drum) raised 5 minutes before and dropped at exactly 12.00 o'clock noon daily.

Museum—(Incidentally, attached to the building is a moderate but well ordered and marked collection of selected specimens from the Islands.)

Comparative Weather Conditions—

Mean Annual Temperature

Baguio	64.4 degrees F.	
Manila	79.8 degrees F.	

Coldest Temperature on record

B.	37.4 degrees F. (Frost January 24, 1919.)
M.	58.1 degrees F.

Hottest Temperature on Record

B.	84.0 degrees F.
M.	101.5 degrees F.

Atmospheric Pressure

B.	637.0 mm. (Not reduced to
M.	759.3 mm. sea level.)

Sunshine (average) E. g.

4 hours, 7 minutes daily during March 1929

Rainfall (average per month)

B.	15.06 inches
M.	6.55 inches

Rainfall for one month

.74 inches (for March, 1929, a dry month.)

36.7 inches (for July, 1928, a wet month.)

Heaviest Rainfall for 24 hours

45.99 inches on July 14, 1911.

Wind (An example of a report for a month.)

9 to 21 miles per hour for March.
East to Northeast, prevailing direction.

(N. B. More detailed data issued daily.)

(Complete record for Baguio and Detailed data from each Philippine Province is in printed Bulletin of the Weather Bureau.)

Points near Baguio—

Trinidad Farm School	7 Kilometers
Antomak Gold Mine	11 Kilometers
Santo Tomas Peak (by road)	15 Kilometers
Haight's Place	50 Kilometers
Damortis	50 Kilometers

Distance of Baguio north of Manila (165 miles) — 278 Kilometers

CHARLES H. ROHLEDER, S. J.

THE CALCULATION OF THE DAY OF THE WEEK IN ANY YEAR

A propos of Father Thomas D. Barry's article (*Science Bulletin*, Volume VII, No. 2), entitled "The Day of the Week Corresponding to a Given Calendar Date", a supplementary note may be added in reference to a convenient tabular solution recently proposed by Joachim Mayr in the *Astronomische Nachrichten* (Band 247, Nr. 5906 Nr. 5907, S.17-S.48). It occurs as an appendix to his article "Umrechnungstafeln fur Wandeljahre", in which conversion tables are supplied for calendar years dating from the year 829 B. C. and continuing till 2051 A. D. The calendars thus coordinated with the Julian and Gregorian calendars are the Egyptian, Armenian, Grecian (Era of the Seleucidae) and Persian, with their various eras.

The appendix of more general interest is a perpetual tabular calendar for finding the day of the week on which any date (reckoned Before Christ or After Christ) falls. At the time from which the Christian era starts, the week as a measure of time was unknown to the Greeks and Romans. Counting backwards, however, according to our present system, we can divide all time into weeks. In the Christian era, the order of days of the week has never been interrupted even by calendar reformation, although the proposed thirteen month calendars with their so-called "Blank Days" would abolish the regular sequence of days.

Mayr's table is constructed "nach dem Grundsatz der magischen Quadrate" so that a set of day numbers may be found both at the intersection of the line containing the *number* of the century, and of the column containing the *year* of the century; and also at the intersection of the line of the *month*, and the column of the *day* of the month. The procedure is simple: Merely find the number at the intersection of the century line and the year column. Add this to the number at the intersection of the month line and the day of the month column. The day of the week corresponding to this sum is given by the small corner tables indicated by the arrows.

There are separate tables on the same page for reckoning years before Christ and years after Christ. For each leap year, a pair of numbers are printed in heavy type in the year columns; for January or February dates in leap years after Christ, take the column of the left number of the pair in heavy type, but for all other months take the column of the year number on the right. For leap years before Christ, do exactly the opposite. In using this method, B.C. years must be diminished by one.

The Calculation of the Day of the Week in Any Year.

Sum		Day
0	7	Saturday
1	8	Sunday
2	9	Monday
3	10	Tuesday
4	11	Wednesday
5	12	Thursday
6		Friday

Days of Month

1	2	3	4	5	6	7	8
8	9	10	11	12	13	14	15
15	16	17	18	19	20	21	22
22	23	24	25	26	27	28	29
29	30	31					

After Christ

Centuries After Christ												
0	700	1400	1700*	6	0	1	2	3	4	5	6	January
100	800	1500		5	6	0	1	2	3	4	5	April July
200	900	1600	1800*	4	5	6	0	1	2	3	4	September December
300	1000	1700		3	4	5	6	0	1	2	3	June
400	1100	1800	1900* } 1500* }	2	3	4	5	6	0	1	2	Febr. March November
500	1200	1900	1600	1	2	3	4	5	6	0	1	August
600	1300	2000		0	1	2	3	4	5	6	0	May
Julian			Gregor.	6	0	1	2	3	4	5	6	October

A. D.

The Gregorian Years 1500, 1700, 1800, 1900 are common years and must be joined with 00*

Years

	00*						
00	**00**	01	02	03	**04**	**04**	05
05	06	07	**08**	**08**	09	**10**	11
11	**12**	**12**	13	14	15	**16**	**16**
—	17	18	19	**20**	**20**	21	22
22	23	**24**	**24**	25	26	27	—
28	**28**	29	30	31	**32**	**32**	33
33	34	35	**36**	**36**	37	38	39
39	**40**	**40**	41	42	43	**44**	**44**
—	45	46	47	**48**	**48**	49	50
50	51	**52**	**52**	53	54	55	—
56	**56**	57	58	59	**60**	**60**	61
61	62	63	**64**	**64**	65	66	67
67	**68**	**68**	69	70	71	**72**	**72**
—	73	74	75	**76**	**76**	77	78
78	79	**80**	**80**	81	82	83	—
84	**84**	85	86	87	**88**	**88**	89
89	90	91	**92**	**92**	93	94	95
95	**96**	**96**	97	98	99		

Years

For LEAP YEARS (in **heavy** lettering)

Use Year Number on the:

B.C.	right	left
A.D.	left	right
for	January and February	March to December

For the calculation, all B.C. years must be diminished by one.

Before Christ

October	3	2	1	0	6	5	4	3	0	700	1400	2100	2800
May	4	3	2	1	0	6	5	4	100	800	1500	2200	2900
August	5	4	3	2	1	0	6	5	200	900	1600	2300	3000
Febr. March Nov.	6	5	4	3	2	1	0	6	300	1000	1700	2400	3100
June	0	6	5	4	3	2	1	0	400	1100	1800	2500	3200
Sept. December	1	0	6	5	4	3	2	1	500	1200	1900	2600	3300
April July	2	1	0	6	5	4	3	2	600	1300	2000	2700	3400
January	3	2	1	0	6	5	4	3	700	1400	2100	2800	3500
									Centuries Before Christ				

B.C.

					31	30	29
29	28	27	26	25	24	23	22
22	21	20	19	18	17	16	15
15	14	13	12	11	10	9	8
8	7	6	5	4	3	2	1

Days of Month

Sum		Day
0	7	Saturday
1	8	Sunday
2	9	Monday
3	10	Tuesday
4	11	Wednesday
5	12	Thursday
6		Friday

A few examples and notes will be given. January 1st, 1114 A.D., equals 1100 plus 14.

Century line 1100 Year column 14	intersect at 6	Sum equals 12, therefore day of week is THURSDAY.
Month line January Day column 1	intersect at 6	

According to the system proposed by Joseph Justus Scaliger in 1582 and widely adopted by astronomers, a date is expressed as the number of days elapsed since January 1, 4713 B.C., the beginning of the arbitrary Julian Period containing 7980 *Julian* years (i.e., years of which *every* fourth one contains 366 days). This first day of the Julian Period fell on a Monday as we reckon it now, for:

Century line 4700 Year column 13—1, or 12	intersect in 6 (since it is a leap year).	
Month line January Day column 1	intersect in 3.	The sum equals 9, therefore the day is Monday.

The method for finding the day of the week holds also for those centurial years which are not leap years, and a special 00 printed in light type is inserted in the year column for such "common years" in the Gregorian calendar.

The formulae and proof of this method are given in Joachim Mayr's previous article "Neue Wochentagbestimmungen" in the *Astronomische Nachrichten* (Band 235, Nr. 5624, S.161-S.174). It is interesting to note that from the first of March, 200 A.D., till the 28th of February, 300,—the Julian calendar coincides with the Gregorian calendar calculated backwards to that time, although at the time of Pope Gregory's correction of the Julian calendar (under the advice of Father Christopher Clavius, S.J.), ten days (October 5-14, 1582) had to be dropped in order to have the vernal equinox come on March 21st. For conversion of Julian dates to Gregorian, 13 days must now be added, and beginning March 1, 2100, 14 days will have to be added to the Julian date. Before 200 A. D., the correction to Julian dates is negative, amounting to 24 days from 3001 to 2901 B. C.

For those who are interested in finding the day of the week for A.D. dates, reference should be made to the Jesuit Father John Gerard's article on Chronology in the *Catholic Encyclopedia* (Vol. III, pp. 738-742) for the following convenient method of finding the day of the week, dispensing with tables.

A. ADD TOGETHER:

1. The number of the year (i.e., the last two figures of the whole date). For dates in January or February, the year before must be taken.
2. The fourth part of this number, disregarding the remainder.

3. The day of the month.

4. The number in the following series, according to the month.

JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
6	2	1	4	6	2	4	7	3	5	1	3

B. Now take the number of the *century* (i.e., the figure or figures left after the last two figures have been cut off). If OLD STYLE (i.e., according to the Julian calendar), subtract this century number from the next higher multiple of seven. If NEW STYLE (i.e., according to the Gregorian calendar), divide the century number by four, and subtract twice the remainder from nine. In *either* case, add the result to the sum previously found for A.

C. Divide the total by seven. The remainder shows the day of the week:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7 or 0

For instance, let us find on what day of the week St. Ignatius and his nine companions took their first vows at the Church of Our Lady of Montmartre on the Feast of the Assumption in the year 1534:

Year number, 34; plus $\frac{34}{4}$ or 8 (disregarding the remainder); plus the day, 15; plus the month number for August, 7; plus the century number 15 subtracted from 21,—equal 70. Seventy divided by seven leaves a remainder of 0, which corresponds to Saturday.

In our modern histories, years are always given according to the Gregorian calendar or New Style, but the month and day are otherwise left as they were originally recorded. There is a classic example. Queen Elizabeth died on the 24th of March, 1602, the last day of the year according to the Old Style or Julian calendar; but she lived until the 3rd of April, 1603, according to the New Style. This date is recorded in histories as the 24th of March, 1603, but to avoid ambiguity it is frequently expressed as $\frac{\text{24 March}}{\text{3 April}}$, $160\frac{2}{3}$.

Accordingly, in using the "Tabellenlose Methode" described in the Catholic Encyclopedia, you must know whether the date in question is O.S. or N.S. For example, Mary Queen of Scots was executed on the 8th of February, 1587 ($158\frac{6}{7}$), which was a Wednesday. Treating this as N.S., would give 86 plus 21 plus 8 plus 2 plus (9-6) equals 120. $\frac{120}{7}$ gives a remainder of 1, therefore Sunday would be indicated—erroneously. England, however, did not accept until 1752 the calendar promulgated in 1582 by Gregory XIII. Consequently, in finding the day of the week, one must reckon this date either as February 18, 1587 N.S., using either this or

Mayr's Method; or else treat it as an O.S. date, as follows: 86 plus 21 plus 8 plus 2 plus (21-15) equals 123. $\frac{123}{7}$ gives a remainder of four, therefore Wednesday is indicated—correctly.

In this connection, a valuable reference is Clarence E. Woodman's 16-page pamphlet "A Perpetual Ecclesiastical Calendar", showing by simple inspection of tables the dates of the principal feasts of the Church's year from the beginning of the Christian era to the year 4499 A.D., with rules and formulae for unlimited extension (New York, The Columbus Press, 1905).

Still another reference may be given to an ingenious "Multidate Master Calendar" only 4" x 4", manufactured by Albert Orme, 314 East 23rd St., New York City. This device by means of a clever dial used in conjunction with a single century-table, reduces the year to one of the 14 possible calendar years (7 for common years and 7 for leap years), and reckons back to any day of the week for either B.C. or A.D. dates, provided that they are expressed according to the Gregorian calendar. An 18-page pamphlet calendar for the 250 years from 1753 to 2002, A.D., showing the day of the week of every date, is published by A. & S. Cunningham, South Norwalk, Conn. Next to the year numbers in the first table, is printed the calendar number for that year. Reference to the proper one among the 14 calendars, gives the day of the week for each date in the year. Prescinding from disturbances caused by those centurial years which are not leap years, the sequence of calendars is repeated regularly every 28 years.

WALTER J. MILLER, S.J.

EDITORIAL

(Continued from Page 116)

River to the site of the projected Hoover Dam. These four tunnels are fifty-six feet in diameter and over three thousand feet long. At St. Nazaire, France, the largest passenger boat ever built was launched, the Normandie; its motive power is derived from four electric motors, totaling 160,000 horsepower. Building and highway construction also made notable advances.

In archeology too, a number of discoveries were made; most interesting of all were those made in Palestine, and in Minnesota and Nebraska.

These are just a few of the outstanding facts added to our recent knowledge, but sufficient to prove that the "march of science" still goes on.

BIOLOGY

THE NEW KNOWLEDGE IN BACTERIOLOGY

Rev. Clarence E. Shaffrey, S.J.

There is an interesting phenomenon known as the dissociation of bacteria. It has become an object of research in the last few years, for it is an important discovery which seems to upset the old idea of the simplicity of bacterial life and it suggests a relation between the well-known forms of bacteria and the ultramicroscopic viruses.

Many species of this dissociation have been observed. Bacteria descended from a single cell break up into several strains which have characteristics which clearly distinguish them from one another. For instance, these changes may relate to the morphology of the individual bacterium, or to colony formation, or to capsule production, to virulence, motility, resistence to phagocytosis, etc. The morphological dissociation results in a change from elongated bacteria to shorter rods and to cocci and finally to filterable forms which after a number of transplants develop into the original common form familiar in the laboratory.

Whether or not there are such filterable forms which are a stage in a cycle is a question. Possibly these so-called filterable forms are merely fragments of the original cell which are quite likely produced by a degeneration into granules by bacteria which multiply by fission. Should these fragments contain chromation they could readily develop into the original form. Such a happening could hardly be regarded as a regular and constant stage in the life-cycle of a germ.

There has been some work done recently by Hauduroy of France which seems to demonstrate a changing cycle for the bacillus typhosus. It appears that the bacilli of typhoid and paratyphoid fevers are capable of assuming invisible forms, possibly under the influence of bacteriophage. These invisible forms are found in some patients either in the blood in the early stage of the disease or in the stools in the later stages. They are capable of producing septicaemias in which the normal bacterium is not found. This fact may explain typhoid fever produced by water in which the normal bacterium is not found. The cycle of the bacillus then may be infection by a filterable form, then the development of the normal form in the body of the infected individual, and a return to the invisible form at the termination of the disease. The details of this work have not appeared but are to be published soon. Similar work on the tubercle bacillus seems to indicate a polymorphism for that germ. The bacillus of leprosy has been subjected to similar experiments with like results.

The Journal of the A. M. A. for August 27, 1932, reports the application of Hauduroy's method by Ryan and Arnold of the University of Illinois. These men demonstrated granules in sterile body fluids which passed through two or three intermediary stages and finally became transformed into normal bacteria. They also fed bacillus prodigiosus and later obtained sterile stomach and duodenal smears. No growth was seen until after the fifth transplant. Here there was shown a spindle-shaped bacterium with pointed tapering ends. Later transplants gave colonies of tangled threads. In the plate of the tenth transplant the pigment characteristic of the bacillus prodigiosus appeared and the twelfth transplant showed the characteristic form of the bacillus prodigiosus cultivated in the laboratory.

The change from non-capsulated to a capsulated form has been accomplished at the Rockefeller Institute. It has been found that pure cultures of virulent type pneumococci grown under less favorable conditions dissociated into mixed cultures of two or more different morphologies, specificities, virulences or cultural characteristics. A mutant which is uncapsulated and non-virulent is readily produced. This breeds true for many test tube generations. By injecting this involution form into mice, together with a large dose of heat-killed uncapsulated pneumococci, Griffith in 1928 managed to recover from the heart blood, living capsulated pneumococci. The capsules similated those of the heat-killed pneumococci.

Dawson and Sia (1930) accomplished the same in vitro, and Alloway (1932) grew the naked bacteria in a test tube in the presence of somatic anti-serum plus a large amount of heat-killed alien pneumococci filtrate and obtained the same result.

C-E. A. Winslow of Yale, addressing the Society of American Bacteriologists at Baltimore in December, 1931, recalled that as long ago as 1877 Nageli published a work on pleomorphism in bacteria in which he held for a very wide range of variability and mutual transformations between bacteria of widely separated groups. These extreme ideas were soon overthrown by Koch, Cohn and Migula and their followers who held for fixed and simple types of bacteria, and impressed their ideas on bacteriology for thirty years. Winslow reminded his hearers that certain changes of a physiological nature were noted repeatedly but these were due to environmental conditions, the bacteria, however, remaining stable. One such change was the attenuation of bacteria exposed to unfavorable environment made use of by Pasteur in his preparation of anthrax vaccine. Like changes were the increase in virulence by passing bacteria through suitable animal hosts, non-development of pigment at certain temperatures, etc. But it was not until Neisser (1906) and Massini (1907) by their work on B. coli mutabile, and Twort's demonstration of new fermentative powers acquired by the colon-typhoid group, that the old ideas were really threatened. From that time to the present more and more instances of dissociation and transformation have been observed, so that now bacterial dissociation according to Winslow has been demonstrated beyond question. Winslow emphasized the fact that while these variants breed true for a number of generations they are not mutants in the true biological sense, for they tend to return to the parental type or to change from one to another, which true mutants do not. He states too, that the phenomena of gonidial formation as a reproductive stage in the life-cycle of the colon-typhoid organisms, and the filterability of the minute forms of some of the common bacteria are established beyond question, and he regards the work of Morton Kahn in which the entire process of cell-disintegration and reintegration have been observed under the microscope in single-cell cultures as evidence which should convince the most skeptical.

However, not all are convinced, and no less a man than Professor Hans Zinsser of Harvard makes a plea for clearness, stating that there are two distinct questions, one that of the filterable stages of true bacteria, and the other of the cyclic relationship between the true bacteria and the ultra-microscopic viruses, and that these two have very often been confused in as much as investigators left it difficult to determine from their writings "whether they advocate one of these theories only, or whether in claiming the truth of one they mean to imply that of the other as well." He deplores the confusion and holds Koch before us as an "uncompromising disciple of the truth" and recommends that in this matter we adopt certain postulates similar to those of Koch in order that "loose reasoning" may not block progress. He sets up the following postulates in order to demonstrate the principle of a cycle between filterable and non-filterable forms of a bacterium.

(1) It must be possible to filter a suspension of a well-defined pure culture of bacteria through a filter which holds back the characteristic forms; and these original forms should not appear in the filtrate or in the cultures made with adequate amounts of the filtrate on suitable media after incubation of at least two or three weeks.

(2) There must be evidence of growth of some kind in cultures made of this filtrate, but without evidence of the presence of the original forms.

(3) The culture of the filterable or minute form must be carried in series of several generations.

(4) It must be possible to recover the normal forms from such successive filterable attributes.

On the basis of these postulates he rejects the work of Mellon, Rosenow and Kendall, and suspends judgment on Hadley's work which he regards as not yet sufficiently confirmed, and emphasises the fact that Hadley rejects any implication that he suggests identification of his filterable forms with the so-called ultramicroscopic virus groups.

Zinsser finds even greater danger of confusion in the suggestion that the infectious agents of herpes, poliomyelitis, etc., are merely filterable or ultramicroscopic forms of common bacteria.

As establishing the cyclic relationship between bacteria and the virus group he would demand the fulfillment of the following postulates:—

"Starting with a virus capable of producing a characteristic disease with all the clinical, pathological and immunological criteria necessary for its recognition, the investigator must:

(1) Repeatedly cultivate a bacterium of a single well-defined species.

(2) He must carry this bacterium through a number of culture generations. (If he can produce the disease, in the animal susceptible to the original virus and in a characteristic way with these cultures, all the better. But this need not be required since virulence may change with form. However, we would attach no importance to such experiments as those of Rosenow with poliomyelitis, in which the bacterium produced a disease in rabbits and ginea-pigs—species entirely resistant to the original virus.)

(3) After a number of bacterial culture generations, it must be possible to get back the virus itself—apart from the bacteria—either by culture or by animal innoculation; the culture generations must be sufficient in number to insure complete removal of the original virus by adequate dilution; and such recaptured virus must possess all the original characteristics as to filterability, specific pathogenicity, etc., of the original material."

Professor Zinsser is of the conservative type and is not in a hurry to accept as new discoveries certain phenomena which are extremely attractive because of the broad field of research they open up, and because of the possibilities of advancement along the lines of resistance to infection and the production of artificial immunity. With his steadying influence on this science here in America we can feel assured that the new knowledge in bacteriology will be evaluated correctly.

CORRESPONDENCE

Buffalo, N. Y.

DEAR EDITOR:

In answer to a query of your correspondent appearing in the May, '32, issue of the 'BULLETIN' I shall endeavor to present a few notions concerning the course in 'Biology and Evolution' which was offered at Canisius College last year.

It is to be noted that the course was intended primarily for students in the College Courses for Teachers and open to such of our students who had previously at least one year's work in biology. Since our College Courses for Teachers are conducted if not in competition, at least concurrently with similar courses offered in two nearby secular institutions, one reason for the introduction of such a course as the one in question must be evident. Such a course is not a mere 'credit course' but an earnest effort to present clearly instruction in the scientific and philosophical principles involved in a very complex and much-vexed problem. In view of the special needs of the students for whom the course was primarily intended and to anticipate their needs in future contacts the course in evolution was introduced. It is known for instance that some of these students at a future debate will be taking similar or closely related course at either of the neighboring institutions.

With the promise that no text was used but the notes of the lecture, may I be permitted to sum up the course in six points?

1. The philosophical background, or the chief philosophical points to be observed with reference to the theory of evolution. Such are the existence of a First Cause, a special action on the part of God for the production of matter, vital principle and the soul of man.
2. The origin of matter and considerations of the nature and origin of life.
3. The main theories of evolution . . . Lamarck, Darwin, Theory of Mutations, Orthogenetic Theory and the Theory of Isolation.
4. Considerations of the basic factors of evolution, as heredity and variation. Theories of heredity and methods of studying heredity.
5. Discussion of the evidence adduced from paleontology, morphology, distribution, embryology and experimental biology.
6. Difficulties concerning a belief in evolution because of matter and methodology; inconclusive evidence on the inheritance of acquired characteristics; the negative and positive evidence adduced from comparative anatomy, paleontology and comparative embryology.

The above has been respectfully submitted at some length in the hope that it may interest more than one reader, and the undersigned would be extremely grateful for any suggestion which the above may evoke.

Sincerely in Domino,

JOSEPH KEEGAN, S.J.

APPLICATION TO MEDICAL SCHOOLS

The students of the pre-Medical section of the colleges are already becoming excited about the professional school which may have the honor of enrolling them in next year's classes. Most schools are now demanding a personal interview of all applicants, and that interview is degenerating more and more into an attack on their religious belief. One boy at the interview was asked if he believed that the human soul was immortal; and on his affirmative reply was told that he would be obliged to "drop such nonsense' if he expected to enter that school. To another the statement was made that it was folly to apply, if one believed that 'birth control' was wrong.

At another school, the candidate was asked if he believed in miracles. If so, he should not waste his time studying medicine, but should, if he were conscientious, simply advise all sick people to go to St. Anne de Beaupre. Still another was asked why he wished to enter that particular school, where at the very least, no preference would be shown to a Catholic, rather than go to a school connected with a Catholic University, which would obviously favor those of the Catholic religion. Another on giving his name, was greeted with the insulting remark that he didn't seem to have 'the flannel mouth' which was so characteristic of his race.

The Aptitude Test, also, which is now a pre-requisite in all medical schools, furnishes a convenient method of discrimination against Catholic boys, as the entire examination of the papers is in the hands of a committee, made up of Free Masons. Is it possible that in the near future Georgetown alone will deign to receive boys from Catholic colleges in this vicinity? As an antidote to the above, it may be of interest to state that of fifteen who won appointments recently to the Staff of the Boston City Hospital, seven were graduates of Boston College.

REV. FRANCIS J. DORE, S.J.

CHEMISTRY

RECENT ADVANCES IN CHEMISTRY

Rev. Richard B. Schmitt, S.J.

Even though appropriations have been curtailed and many industrial chemists are without employment, nevertheless the progress made in the field of chemistry during the past twelve months has been phenominal. Practically all chemical research is carried on in the universities and industrial laboratories. The educational institutions usually contribute to theoretical chemistry, while the industrial laboratories contribute to practical chemistry. The world of chemistry numbers several thousand research laboratories, nevertheless there are still superabundant problems waiting for solution. The outstanding problems that are of most interest to mankind are the problems of medicinal chemistry. The entire civilized world is anxiously awaiting a simple remedy for the common cold, tuberculosis, cancer, heart disease and pneumonia. However, chemical research made living conditions more comfortable and transportation more rapid.

In reviewing the current chemical literature, we find recorded there many advances in the varied phases of the vast chemical field, and we recall here some of the outstanding achievements.

In the realm of subatomic structure the latest conception is that of the neutron. The neutron is considered to be a minute particle carrying no free electrical charge. The conception of the neutron was developed to explain extraordinarily penetrating radiation obtained by bombarding beryllium with radiation from polonium. It is assumed to consist of a proton and an electron bound closely together and mutually satisfying their electric charges, and was first conceived by Chadwick in the Cavendish Laboratory of Cambridge University. He found it necessary to postulate such a neutral particle in order to explain some of the phenomena of penetrative radiation which do not fit the accepted views of electrons and protons as charged particles.

Cockroft and Walton, also of Cambridge University, succeeded in disintegrating the lithium atom into two helium nuclei. This result was obtained by bombarding lithium protons under a pressure of about 125,000 volts. A partial confirmation of this work was made by Lange and Brasch in Berlin, who used voltages up to five million in the laboratory of the German General Electric Company to break up lithium atoms.

Two rather important discoveries have been announced in the field of Medicinal Chemistry. From the University College of Science in Calcutta comes the report of a synthetic quinine which possesses the same antiparasitic value as the natural product but it is considerably less bitter. Full information is yet lacking, but the synthetic material is reported, on the basis of preliminary experiments, to be probably more useful than naturally occurring quinine.

At the University of California Medical School, experiments in the use of divinyl oxide show it to be a rapid and efficient general anesthetic. The report of this work, confirmed in the University of California Hospital, states that divinyl oxide acts more rapidly than ether or chloroform, and is more rapidly voided from the system than ether, with less excitement and nausea to the patient. Through its use there is less irritation of the lungs, less disturbance of the heart, and less change of the body's chemical equilibrium than with the older anesthetics.

The most important advances in our knowledge of the vitamins are summarized in several important and successful attempts to isolate and to synthesize them. Karrer at the University of Zurich announced early in the year a structural formula for the growth producing vitamin A, relating it to the turpenes. Previously, Drummond of the University College, London, had shown its relation to carotin and had demonstrated its kinship to chlorophyll. The antiscorbutic vitamin C was isolated and identified by King of the University of Pittsburgh and was synthesized by Rygh of Norway. King isolated the material from lemon juice, long known to be a potent sources of it; Prygh produced a material potent in doses of 0.02 milligrams to guinea pigs by the acid hydrolysis of narcotine, after showing that narcotine, present in unripe fruit, is replaced by the vitamin as ripening progresses. In Germany Windhaus, in Holland Reerink and Van Wijk, in England Bourdillon, and in the United States Bills and MacDonald—all have announced successful conclusions for their respective researches on the isolation of vitamin D.

The separation at Columbia University late last year of the isotope of hydrogen by using low temperature methods has been confirmed by workers at the University of Michigan using hydrogen chloride.

Electrodeposition of tungsten, made possible by the processes of Fink, adds this metal to the ever increasing number of corrosion resistants. By using a solution containing alkali tungstates having a pH of about 12, and carefully controlling temperature and current density within narrow limits, a hard, coherent, smooth coating of the metal can be secured. Indium has been produced in this country in quantities of many grams and is available for investigation with a view to wider application. Metallic rhenium and metallic gallium are offered here at much reduced prices from the German manufacturer. Rhenium, one of the most recently discovered members of the family of chemical elements, possesses great hardness which it is capable of imparting to alloys containing it; gallium has found some application in high temperature thermometers and as a silvering metal for mirrors.

The discovery of large deposits of radium-bearing minerals in the Great Bear Lake districts of Canada has led to the development of a more efficient method of extraction of the element from the ores. Announcements of this from Canadian official sources imply that the quantities of radium thus made available are comparable with those from the Belgian Congo. It is expected that the efficiency of production by the new process will make Canadium radium an important factor in the market.

Helium has been discovered in the Island of Trinidad. Information is still scanty on this discovery, but reports indicate that Trinidad may become a substantial contributor to the world's supply of this rare gas. The Chemical Institute at Bonn states that krypton has been made to combine with chlorine and bromine. From the Pasteur Institute in Paris comes the announcement of a new type of filter possessing extraordinary power of destroying common bacteria. It utilizes the oligodynamic effect of silver and is constructed by introducing silver chloride into clay before firing. The resulting filter has metallic silver distributed through its intertices in finely divided form. Water filtered through the device has no detectable amount of silver in it, yet it retains its germicidal value for several days afterward.

A new corrosion-resistant coating material formed by the polymerization of divinyl acetylene has proved to be remarkably resistant to chemical action and efficient as a protective coating. Unlike natural drying oils this material hardens by polymerization rather than oxidation.

A new machine for making gas from anthracite coal has been developed by the Anthracite Institute. White paper from southern yellow-pine forests has become an actuality as a result of successful experiments conducted by Herty on this subject. Several important developments which have proved their value abroad have been brought to this country and are being put into operation here. A synthetic plastic capable of being formed into useful shapes without the extraordinary cost of huge molds has been imported from Germany. It is reported that pieces of equipment as large as ten feet in any dimension can be successfully molded from this material at a cost comparable with that of some of the stainless alloys.

The program outlined for theoretical and industrial research for the present year is formidable, but many results will no doubt be accomplished, as we witnessed during the past decade.

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MATHEMATICS

A DIAGRAM FOR COMPUTING WEIGHTED AVERAGES

REV. F. W. SOHON, S.J.

The problem of computing weighted averages occurs from time to time, not only in making up marks, but in a number of other cases as well. Simple interpolation of a table is equivalent to the problem of finding the weighted mean of two numbers, and double interpolation is the same problem as finding the weighted mean of four numbers. The solution of the problem of averaging marks where the subjects are assigned different weights is reduced to a reasonably simple mechanical process by means of the Woodstock Percentage Computer designed by Father Phillips. Another method is here described which was devised by the author in 1923 when he did not have access to any such instrument, and which has since been utilized for the solution of a number of different problems. A partial description of this method was published in the BULLETIN, Vol. VII, No. 4, p. 30, by Father C. A. Roth, but as much interest has been shown concerning the general method, it was thought that a full exposition should be offered to the readers of the BULLETIN.

It is supposed that two sets of numbers are given, one set consisting of n quantities N_1, N_2, etc N_n, to be averaged, and the other set consisting of n weights p_1, p_2, etc p_n to be assigned to the n given quantities respectively. The weighted mean of the given quantities is then by definition:

$$M_n = \frac{p_1 N_1 + p_2 N_2 + \text{etc} + p_n N_n}{p_1 + p_2 + \text{etc} + p_n} \qquad (1)$$

It is proposed to devise a graphical method for computing M_n.

The first step will be to show that the operation of finding the weighted mean of n given quantities according to equation (1) can be resolved into a succession of simpler operations each of which consists in finding the weighted mean of two quantities.

Let us suppose that the weighted mean of the first k of the assigned quantities has already been computed. Let M_k be the weighted mean thus found. Then from equation (1) we have

$$M_k = \frac{p_1 N + p_2 N + \text{etc} + p_k N_k}{p_1 + p_2 + \text{etc} + p_k} \qquad (2)$$

If we clear of fractions,

$$(p_1 + p_2 + \text{etc} + p_k)\, M_k = p_1 N_1 + p_2 N_2 + \text{etc} + p_k N_k \qquad (3)$$

On the other hand, the weighted mean of the first k+1 quantities should be by definition

$$M_{k+1} = \frac{p_1 N_1 + p_2 N_2 + \text{etc} + p_k N_k + p_{k+1} N_{k+1}}{p_1 + p_2 + \text{etc} + p_k + p_{k+1}} \qquad (4)$$

The first k terms in the numerator of this fraction form the right hand member of equation (3). If we substitute for them their value as given in equation (3), we obtain

$$M_{k+1} = \frac{(p_1 + p_2 + \text{etc} + p_k)\, M_k + p_{k+1} N_{k+1}}{(p_1 + p_2 + \text{etc} + p_k) + p_{k+1}} \qquad (5)$$

N_{k+1} is one of the given quantities to be averaged and p_{k+1} is an assigned weight. M_k is the weighted mean of the first k numbers, but what its weight is to be considered, has not at yet been defined. Let us define the weight of a mean to be the sum of the weights of the quantities from which it has been obtained. If, therefore, q_k is the weight of M_k, then by the definition just adopted

$$q_k = p_1 + p_2 + \text{etc} + p_k$$

so that equation (5) can be rewritten

$$M_{k+1} = \frac{q_k M_k + p_{k+1} N_{k+1}}{q_k + p_{k+1}} \qquad (6)$$

If we compare equation (6) with equation (1) which is the definition of a weighted mean, we see that the right hand member is nothing but the weighted mean of M_k and N_{k+1}. Hence having found the weighted mean of the first k of the assigned quantities, we assign to this mean a weight equal to the sum of the weights of the quantities from which it was obtained, and then we combine this with the k+1st quantity allowing the latter its assigned weight; the new weighted mean formed from these two quantities with their respective weights will be in fact the weighted mean of the first k+1 assigned quantities with their proper assigned weights.

The process thus described lends itself to an immediate and obvious generalization. We begin by finding the mean of the first two quantities N_1 and N_2 with their assigned weights p_1 and p_2. Their weighted mean M_2 is found by means of the formula

$$M_2 = \frac{p_1 N_1 + p_2 N_2}{p_1 + p_2} \qquad (7)$$

We assign to M_2 the weight $q_2 = p_1 + p_2$. Taking the next quantity N_3 with its assigned weight p_3, we find the weighted mean M_3 of these two quantities by the same process:

$$M_3 = \frac{q_2 M_2 + p_3 N_3}{q_2 + p_2} \qquad (8)$$

and we assign to M_3 the weight $q_3 = p_1 + p_2 + p_3$. The process is repeated until all the given quantities have been exhausted. We have therefore proved the theorem that the process of finding the weighted mean of any number of assigned quantities may be resolved into a series of operations of finding the weighted mean of two quantities, one of which is always the weighted mean last found and has for its own weight the sum of the weights of the quantities from which it was obtained, the other being the next in order of the given quantities which takes its own assigned weight. If we can now find the weighted mean of two quantities, the weighted mean of any number can be found by a repetition of the process.

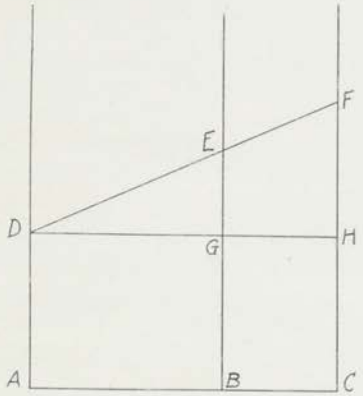

Fig. 1

At three points on a horizontal line A, B, C, (reading from left to right) erect three vertical lines. Let the latter be cut by a transversal in the points D, E, F, respectively (see figure 1), in such a way that CF=N_1, and AD=$_2$. Through the point D draw a line parallel to ABC, and let it intersect BE in G and CF in H. Since the triangles DEG and DFH are similar

$$\frac{GE}{DG} = \frac{HF}{DH} \tag{9}$$

Replace DG and DH by their equals AB and AC respectively, and noting that

$$GE = BE - AD = BE - N_2$$
$$HF = CF - AD = N_1 - N_2$$

make these substitutions in equation (9) and obtain

$$\frac{BE}{AB} - \frac{N_2}{AB} = \frac{N_1}{AC} - \frac{N_2}{AC}$$

$$\frac{BE}{AB} = \left(\frac{1}{AC}\right) N_1 + \left(\frac{1}{AB} - \frac{1}{AC}\right) N_2$$

$$BE = \frac{\left(\frac{1}{AC}\right) N_1 + \left(\frac{1}{AB} - \frac{1}{AC}\right) N_2}{\frac{1}{AB}} \tag{10}$$

Observe that in the above fraction the denominator is equal to the sum of the coefficients of the numerator. Let therefore

$$AC = \frac{a}{p_1}, \quad AB = \frac{a}{p_1 + p_2}$$

and substitute these values in the expression (10) for BE. We have

$$BE = \frac{\left(\frac{p_1}{a}\right) N + \left(\frac{p_1 + p_2}{a} - \frac{p_1}{a}\right) N}{\frac{p_1 + p_2}{a}}$$

$$= \frac{p_1 N_1 + p_2 N_2}{p_1 + p_2} \qquad (11)$$

As equation (11) for BE is the same as equation (7) for M_2, the geometric construction gives us a process for finding the weighted mean of two given quantities, provided the distances AB and AC have the values indicated. Supposing that the distances AB and AC have been correctly chosen to provide the proper weights, the weighted mean is then found as follows:

Lay off on the right hand vertical line (scale of initial entry) a distance CF equal to N_1. Lay off on the left hand vertical line (scale of re-entry) a distance AD equal to N_2. Collinear with F and D find a point E on the intermediate vertical line. The distance BE is equal to M_2 the required weighted mean. If the three vertical lines are calibrated to form scales of equal parts we simply place a straight edge across the diagram so that it cuts the right hand scale in N_1, the left hand scale in N_2, and it will cut the intermediate scale in the required mean M_2. The actual operation of finding the weighted mean is therefore very simple.

In order to construct the diagram the lines must be properly spaced, but fortunately, the rule for spacing is simple.

$$AC = \frac{a}{p_1}, \quad AB = \frac{a}{p_1 + p_2} = \frac{a}{q_2} \qquad (12)$$

In other words, the distance between the scale of re-entry (left hand scale) and any other scale is inversely proportional to the weight of the quantity appearing on that scale. The constant a that appears in (12) is entirely arbitrary. The relative spacings are what count. The value of a determines the total width of the diagram, and when a convenient value has been adopted for this, the position of each scale is immediately determined by the weight of the numbers to be read on it.

We must next extend the process to the case of finding the average of three numbers. We have just read M_2 on a scale at a distance from the left hand scale equal to $a/(p_1+p_2)=a/q_2$. The construction must now be repeated, with M_2 and N_3 as the quantities to be averaged and with q_2 and p_3 as the weights. There is no sense in transfering M_2 to some other scale, so that we make the scale on which M_2 was found one of the scales of the new diagram. Since the width of the chart is arbitrary, we may take the left hand scale (scale of re-entry) for the next quantity N_3 so that we have only one new scale to introduce, the one for M_3. Since the scale for M_2 is at the distance a/q_2 from the scale of re-entry, and since the distances are inversely proportional to the weights, then the scale for M_3 must be situated at a distance from the left hand scale equal to a/q_3. This line is not shown on the diagram.

The method of construction should now be clear. We adopt a fixed order for the assigned quantities N_1, N_2, etc. This order must be kept intact, otherwise the weights p_1, p_2, etc will be applied to the wrong quantities. The weights of the successive means q_2, q_3, etc are next computed. We decide what the total width of the diagram is to be. The total width is equal to a/p_1 so that if we multiply the desired width by the weight of the first entry p_1, we obtain the value of the constant a. The positions of the various intermediate scales are found by dividing the constant a by the respective q's:

Assigned	Weight of Mean	Distance from Scale of Re-entry.
p_1		a/p_1 = width of chart
p_2	$q_2 = p_1 + p_2$	$a/q_2 = a/(p_1 + p_2)$
p_3	$q_3 = p_1 + p_2 + p_3$	$a/q_3 = a/(p_1 + p_2 + p_3)$
p_4	$q_4 = p_1 + p_2 + p_3 + p_4$	$a/q_4 = a/(p_1 + p_2 + p_3 + p_4)$

Having thus obtained the proper spacing, n+1 parallel vertical lines are drawn. The scale on the extreme right or the scale of initial entry must be calibrated because the first quantity N_1 is entered on it. The scale on the extreme left or scale of re-entry must be calibrated because all the other given quantities that are to be averaged must be entered on it. The scale nearest to the scale of re-entry, which is situated at a distance from it equal to a/q_n must also be calibrated, because the answer M_n is read from it. The other intermediate scales, n-2 in number, between the answer scale just described and the scale of initial entry on the extreme right are called hinge scales and need not be calibrated for no numbers are either entered on them or read from them. The problem of calibration is usually solved by drawing the lines on a piece of cross section paper.

To use the diagram we place a straight edge across the diagram so as to intersect the scale on the extreme right in N_1, and the scale of re-entry on the extreme left in N_2. With the point of a pencil or stylus we find and hold the point where the straight edge cuts the first hinge scale which is the one nearest to the scale for N_1 on the extreme right. The straight edge is now rotated about the point we are holding as a pivot, until it intersects the scale of re-entry at the next quanity N_3. The stylus is then moved to the left along the straight edge to the next hinge scale and forms a pivot about which the straight edge is rotated until it intersects the scale of re-entry in the next quantity N_4. We proceed in this way until all the quantities have been entered. Remember that all numbers except the first are entered on the scale to the extreme left. When the last number has been entered, then instead of moving the stylus to the left as heretofore, we simply read where the straight edge cuts the answer scale, and this is the weighted mean M_n.

The method thus described has the advantage that the diagram is easy to construct, so that the apparatus costs practically nothing. The method of use is as simple, if not simpler than the method of operation with the Woodstock Computer. It has the disadvantage that a separate diagram must be drawn for each different combination of weights, and that the order of entries must be kept intact. If the diagram is made too narrow poor intersections may occur.

If equal weights are to be averaged, the distances of the various scales from the scale of re-entry become respectively a, a/2, a/3, a/4, a/5, etc. When such a diagram is constructed, its general utility is enhanced by calibrating all the scales.

If only two quantities are to be averaged, the construction becomes much more simple. The distance between the answer scale and the scale of initial entry

$$BC = a/p_1 - a/(p_1 + p_2) = AB \frac{p_2}{p_1}$$

or

$$\frac{AB}{BC} = \frac{p_1}{p_2} = \frac{\text{Distance to scale for } N_2}{\text{Distance to scale for } N_1}$$

so that the construction can be made by first drawing the answer scale,

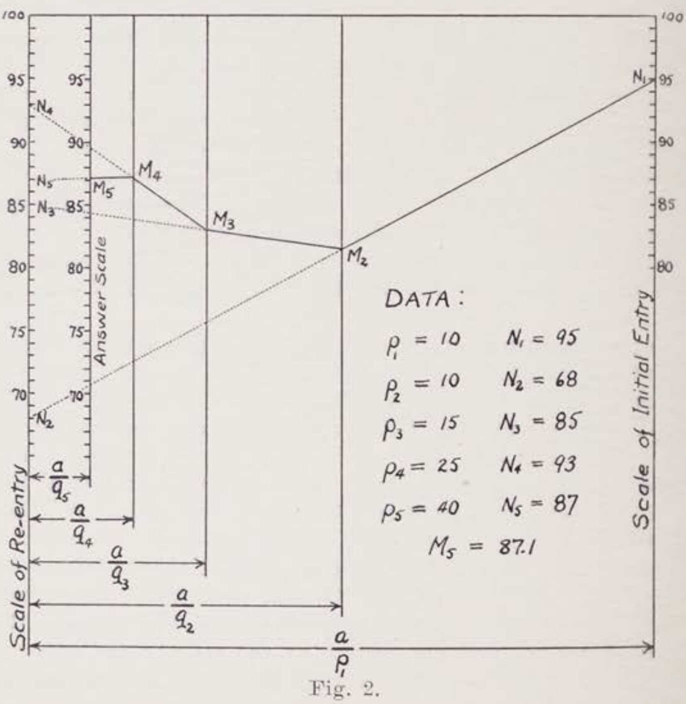

Fig. 2.

then laying off p_1 to the left and erecting a scale for N_2; then laying off p_2 to the right and erecting a scale for N_1. For instance, if we want the quantities weighted in the ratio 2:1, we place one scale one inch to the left of the answer scale, and the other scale two inches to the right—and remember to enter the quantity with the greater weight on the scale that is nearer to the answer scale.

To provide a numerical example of the general case that will serve as a model, a diagram has been drawn in figure 2 for the combination of weights set on page 3 of the booklet for the Woodstock Percentage Computer.

Subject	Weight			
Civics	10		$a/10 = 10$	(assumed, making $a=100$)
History	10	$q_2 = 20$	$100/20 = 5$	
English	15	$q_3 = 35$	$100/35 = 2.86$	
Greek	25	$q_4 = 60$	$100/60 = 1.67$	
Latin	40	$q_5 = 100$	$100/100 = 1.00$	

The set of marks; Civics 95, History 68, English 85, Greek 93, Latin 87, have been averaged, the different positions of the straight edge being indicated by transverse lines. As there were no grades below 68, only the upper part of the diagram was drawn.

TRIGONOMETRY MADE EASY

Kevin J. O'Brien, S.J.

Two of the fundamental formulas in Trigonometry are 1) $\tan = \frac{\sin}{\cos}$, and 2) $\sin \cdot \csc = 1$. From these two formulas we can easily work out numerous other formulas involving the same principles shown in (1) and (2). The simplicity of the derivation of these other formulas, using Fig. 1 as a guide, should not only prove useful to the student of Trigonometry, but will certainly add interest and a certain amount of entertainment to what might otherwise be monotonous work.

(A). As regards the first formula mentioned above, viz.; $\tan = \frac{\sin}{\cos}$, if we read the functions written about Fig. 1, and begin reading clockwise, with tan, we notice that the first three functions we read, (tan, sin and cos,)

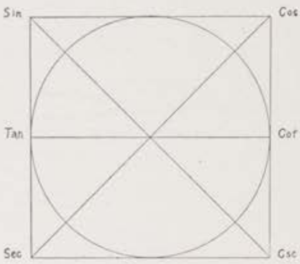

Fig. 1

are the three functions related in the first formula. So with Fig. 1 in mind we can postulate: the tan is equal to the function immediately following divided by the second following function. Now this rule can be applied to each of the six functions about the square, beginning with any one function, and reading clockwise. Therefore, any function written about Fig. 1 is equal to the function immediately following, reading clockwise, divided by

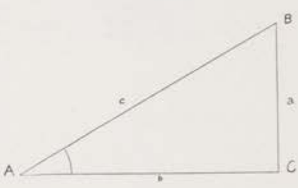

Fig 2

the second following function. Checking from Fig. 2, where $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, and $\csc = \frac{c}{a}$, we find that

$\tan = \frac{\sin}{\cos}$, $\sin = \frac{\cos}{\cot}$, and so for all six functions. Not only is this true reading counter clockwise also; for $\sin = \frac{\tan}{\sec}$, $\tan = \frac{\sec}{\csc}$, and so for all six functions.

(B). The functions written at the terminals of each diagonal of the square are reciprocal functions, and the functions written at the terminals of the diameter of the inscribed circle are also reciprocal functions. This is, $\sin \cdot \csc = 1$, $\cos \cdot \sec = 1$, and $\tan \cdot \cot = 1$.

(C) Any one of the six functions is equal to the product of the two functions on either side of it; e. g., $\sin = \cos \cdot \tan$. $\cos = \sin \cdot \cot$; and so for all six functions.

(D). Since it is true that $\sin \cdot \csc = 1$, and that $\csc = \frac{\cot}{\cos}$, we can say that $\sin \cdot \frac{\cot}{\cos} = 1$; and with Fig. 1 again in mind postulate: any one of the six functions multiplied by the quotient of the second following function and the immediately following function is equal to 1; so $\cos \cdot \frac{\csc}{\cot} = 1$; and so for all six functions. This formula also may be read clockwise or counter clockwise.

(E). Reading clockwise or counter clockwise, (although in this case either reading will give us the same result), the product of three functions, when we take only every other function in our reading, is equal to 1; e. g., $\sin \cdot \cot \cdot \sec = 1$, and $\tan \cdot \cos \cdot \csc = 1$. And from this it follows that all the six functions when multiplied together give 1 as an answer.

A visualization of Fig. 1, and a ready familiarity with its use is a great aid to speed in doing a number of examples in Trigonometry. The formulas derived by this simple memoria technica are accurate.

The ease of using Fig. 1 can be shown in these examples: 1) Prove that $\frac{\sin \cdot \cot}{\cos} = \tan \cdot \cot$; Work: from the diagram, $\tan \cdot \cot = 1$ and $\sin \cdot \cot = \cos$; so $\frac{\cos}{\cos} = \tan \cdot \cot$. 2) Prove that $\frac{\cos}{\sin} = \cos \cdot \csc$; Work from Fig. 1, and the explanation in (A), $\frac{\cos}{\sin} = \cot$; and from (C) $\cos \cdot \csc = \cot$; so $\cot = \cot$. There are many examples in any text book of Trigonometry in which this simple method may be used to work out examples or to check answers.

NOTE: The development of such a plan as this came from a suggestion given in a Trigonometry class several years ago. I have not been able to find it in any book nor do I know of its original source.

PHYSICS

CHANGE IN TERMINOLOGY TO SUIT MODERN PHYSICS?

Rev. Joseph J. Lynch, S.J.

The purpose of this short article is to promote discussion as to the advisability of modifying some of our philosophical terms in view of the findings of Modern Physics. Unfortunately, many terms are used quite loosely by modern scientists. Professor Arthur Compton and in fact modern physicists quite generally, speak of the "annihilation" of matter, e.g. the annihilation of a proton and electron (hydrogen atoms) with a release of energy of 109 electron volts. It is clear that they mean "transformation" of matter into energy, but it is also clear that they do not understand by energy a form of matter. If you ask them for instance, "Is this energy thus released material?" They will answer emphatically, "No." "There is no matter there, it is all energy." If you give them the alternative, "But it is either material or spiritual," they answer, "It is material as opposed to spiritual but it contains no matter such as bodies are made up of." The Physicist needs a new word which can be applied to matter and energy as opposed to spirit. I am not suggesting that the philosopher change any of his terminology to accommodate this looseness of speech, though he might be able to help the physicist find some appropriate terms. But do you know of any cases where a change of philosophical terminology would be advisable? I refer only to cases where not through any looseness of terms, but through our increased knowledge, a word no longer exactly fits the cases it was originally intended to fit.

I shall confine myself to one suggested example. It is not my own but was suggested by an eminent Catholic Physicist. How are we to define accidental changes as opposed to essential?

Consider a piece of iron. Its shape has hitherto been considered accidental and a change of shape, e.g., on a blacksmith's anvil, an accidental change. But this accidental change of shape does not differ physically from a change of state e.g. from ice to water. The internal forces responsible for both changes of shape and change of state differ quantitatively but not qualitatively.

This change of state in turn does not differ physically from a change of substance. The internal forces responsible for change of state and change of substance again differ only quantitatively not qualitatively, e.g. the forces holding electrons and protons together in the rock salt crystal conformation are essentially the same as those holding electrons and protons together in the ice formation.

Given the same number of electrons and protons, we can have two different substances by varying the force quantitatively. Because of practical difficulties such transmutation cannot be produced at will but it has been accomplished in a few cases and is theoretically possible in all.

Are we then warranted in calling one change (change of shape) accidental and one change (change of substance) essential since both are produced by the same force but in different quantities? I think we are, just as (facetiously) we distinguish between whipped cream and butter though a greater or lesser whipping produces one or the other. The suggestion has been made that all such changes be called substantial. Another suggestion is that they all be called accidental. I propose the suggestions for discussion and de bait from other anglers.

NOTES: PHYSICS DEPARTMENT; GEORGETOWN UNIVERSITY

Rev. Emeran J. Kolkmeyer, S.J.

The addition of one hour per week of quiz to the Junior schedule has had gratifying results. The purpose of the quiz was manifold: to keep a regular check on the student's advance, to give exercise in translation of ideas into symbols and symbols into ideas, to clear from examination papers mere definitions and memory statements of the physical laws, and finally to coordinate the lecture and laboratory work.

It has succeeded. With a ten minute written paper each week the progress of the class is always evident. Holes are found in the lecture presentation and the remedies applied in time. Part of the time is devoted to simple problem and now many of the students recognize a formula for what it is: a symbolic (and brief) statement of a law of nature instead of a reproduced Egyptian hieroglyph. There was time, particularly at the beginning of the year, for a brief review of fractions, equations and a few ideas on the triangle. Logarithms were stressed.

As an example we might cite one of the Junior sections of 37 men. For the quiz it was divided into two parts, 19 and 18 men. The first part missed three weeks of quiz before a test on November 18, the second part of the class missed none. In the test the first part ran an average below passing, and had only 5 men over seventy (70%); the second part listened to the same lectures, had the same average ability and took the same test, yet ran an average 4% higher, and had twice as many men over the 70% mark.

In the ordinary form of the photometer the screen is moved and the two lamp distances must be squared for each determination of the candle-power. When a large number of such determinations are to be made, as in finding the light distribution of a lamp or lamp and shade the time necessary for the computation may be all out of proportion with the good attained by the student. We hope to cut this labor in half by mounting the standardized lamp and the screen on a single long carriage so that the standard lamp—screen distance will be a constant for the whole experiment. For other lamps the distance may be changed by unscrewing one clamp.

The new photronic cells are more convenient but secondary instruments. In the first year physics occurs it is thought better to stick to fundamentals and compare light with light.

The course in Physical Optics begun this year made the acquisition of some new apparatus imperative even in these times. The new Central Scientific Co.'s Spectograph is on trial here. It has performed rather well. Another C.S.C. lathe type optical bench and another nodal slide fill the needs in that line, for our present small class. A simple form of apparatus for measuring Newton's rings was also purchased from the same company. A plano-convex len of about 400 mm. radius rests on a black glass flat, mounted in turn on a small rotating table. The lens is kept in position by a heavy collar of metal.

One of the necessities of a light laboratory is a supply of simple, inexpensive monochromatic light sources that will be clean-working in the hands of the students. Father Brock suggested trial of the sodium salt rods made by the Eastern Science Supply Company of Boston. They are 5 inches long and sold cheaply enough at 75 cents a pair. In a week's time we mây be able to report on them.

For still better work a comparatively cheap monochromatic light source is one of the new mercury arc lamps of the C.S.C. The type with the heating element wrapped about the cathode seems best for undergraduates. It starts automatically, needs no outside resistances and no tilting. Fixed on a short 10 mm. rod and housed in a covering that thoroughly provides a mount for filters it is a very convenient and compact light source for spectrometer, interferometer or optical bench. The Wratten No. 65 2 inch square filter in 'C' glass is the mercury green and does well enough for all ordinary work.

The so-called Vapor lamp of the same company is a very intense and useful light source for special students. In the regular classes its open construction, its separate resistance, the necessary reduction of resistance and the tilting are a hazard. One bump will cost $13.50 for renewal.

SEISMOLOGY

SEISMOLOGY IN THE PHILIPPINE ISLANDS

By W. C. Repetti, S.J.

Of the Weather Bureau, Manila.

We do not know how far into the past the traditional records of earthquakes extended. The historical record which we now possess commences with the year 1599. We may safely believe that it contains at least all of the severe earthquakes since that year. We owe this record to the painstaking search of Father Saderra Maso.

The instrumental observation of earthquakes began shortly after the establishment of the Manila Observatory, at the then Ateneo Municipal. Seismic instruments of those days and for many succeeding years were crude affairs and responded only to very perceptible shocks. The earliest extant record that we have is that of an earthquake on December 29th, 1872. Manila seems to have been free of any strong earthquakes for the eight years. In 1880 there was the series of extremely severe shocks that caused great damage in the city and surrounding country, with the loss of twenty lives in Manila.

These earthquakes aroused a new interest in seismology and may be said to have given an impetus to the work which has persisted to the present time. Father Faura, the Director of the Observatory, set about the acquisition of better apparatus. Italy was then, and for many succeeding years, the leading country in seismological work and it was to the Italian seismologist that Father Faura turned.

Between 1881 and 1889 the observatory acquired the Bertelli Tronometer, the Cecchi seismograph, the Cecchi microseismograph, and the Rossi seismoscope. Two instruments, the Gray-Milne and the Milne Duplex Pendulum, were obtained from Japan in the late 80s. At the close of the century Professor Vicentini, an Italian, developed the seismograph which bears his name and one of these was acquired by the observatory in 1901. Omori, the well-known Japanese seismologist, developed a simple and rather effective seismograph making use of the horizontal pendulum. A seismograph of this type was constructed in the observatory in 1907.

During the first decade of the present century the Germans became actively interested in seismology, and, with their characteristic thoroughness, soon became the leaders in the science, from the theoretical as well as the practical viewpoint.

Wiechert's Inverted Pendulum marked a decided advance in instrumental seismology and one of these pendulums was acquired by our conservatory in 1911. From then on, three distinct types of seismographs were kept in continuous operation, the Vicentini simple pendulum, the Omori-type horizontal pendulum, and the Wiechert inverted pendulum.

The World War and its consequent readjustments prevented any further development during that period. It was not until 1927 that a modified Galitzin seismograph at a reasonable price came on the market. In 1929 the observatory acquired a complete three-component set of this type known as the Galitzin-Wilip. This is a galvanometric-photographic registration seismograph.

At the present time our operating equipment comprises the Galitzin-Wilip, the Wiechert, and the Horizontal pendulums. All of the older instruments are still preserved in the observatory and constitute a collection that is probably unique.

No accurate, modern seismological work can be carried on without a time service which is correct, or whose correction is known, to one second. In the Manila Observatory we have had such a time service for a number of years. At present there are three highly accurate clocks, two Rieflers and one Synchronome, operating under carefully controlled conditions of temperature and pressure, and checked daily.

So much for the Central Observatory. At Butuan and Baguio we have Wiechert Inverted Pendulums of a smaller size than that in Manila. At Mambajao, Comiguin Island, and at Ambulong near Taal Volcano, we have Vicentini seismographs. These two latter instruments are kept in operation as checks on possible activity in the neighboring volcanoes.

Aside from this instrumental equipment, all Meteorological observers are instructed to report to the observatory the time and intensity of all earthquakes felt at the stations. Such reports are known as macroseismic reports in contradistinction to seismograph records which afford the microseismic data.

When an earthquake is felt or recorded the first question that arises is, where did it originate? By this we ordinarily mean the point on the earth's surface that marks the center of the area over which the quake was felt, or the point of greatest intensity. This point is technically known as the epicenter. In the case of a strong earthquake a number of macroseismic reports enable us to fix the epicenter with a fair degree of accuracy. Great accuracy can not be expected because these reports depend on the perception of several individuals and their judgment of intensity is based on a rather indefinite scale. Our next recourse is to the seismograms. In the records of the vibrations there are characteristic phases and the time interval between these phases bears a definite relation to the distance of the earthquake from the observatory.

Only under very definite and special conditions can we determine the direction of an earthquake from the data of a single observatory. If we have the distance of the earthquake from three or more stations it is a simple matter to locate the earthquake. A still more accurate method is that in which we employ the microseismic data of a number of observatories having an accurate time service. This method has been applied to a number of Philippine earthquakes with interesting results. The data used were obtained from the observatories of Japan, from Zikawei, Hong Kong, Phu Lien, Batavia, and in some cases from more distant stations. This necessarily limited the number of earthquakes treated to those which were strong enough to give good results in those observatories. Another limitation existed in the fact that only in the last ten years has there been a good seismic installation at Hong Kong, and only in the last six or seven years at Phu Lien, important stations for determining Philippine epicenters. We have found that, with very few exceptions, all of the strong earthquakes of the decade 1920-1929 took place under the China Sea, the seas of the Philippines or the Pacific. Furthermore, these locations are found on the portions of the sea bottom where there are definite slopes or deeps, where according to the findings of geology the folding of the earth's crust is taking place, or has taken place and where, consequently, a condition of strain is to be expected. On the Manila seismograms I have seen only one record which appeared to have been caused by an earthquake within the limits of the city. It was too weak to have been perceived by persons, the movements being very small. The earthquakes which have been felt in Manila have not originated in any one locality. They have come from the Ilocos coast, the Zambales coast, Verde Island passage, north central Luzon and from the east.

The two destructive earthquakes of modern times which have affected Manila, those of 1863 and 1880, originated in the east. Alvir, in an article in the Philippine Journal of Science, inclines to the belief that the earthquake of 1863 was a movement on one of the boundary faults of the Mariquina valley. Father Saderra located them in or near the eastern Cordillera. The view of Alvir is based on geological considerations, that of Father Saderra on macroseimic reports. I am inclined to the belief that the epicenter of these quakes was in the region of the Polillo Islands. My opinion is based in general on the fact that a great majority of strong earthquakes have taken place under the sea; and in particular, on the facts that our seismograph records show a number of earthquakes from that region and that some of the earthquakes felt in Manila in the past three years have definitely located in that area. A strong earthquake in that locality could very easily cause damage in Manila. These reasons are not conclusive but to me they seem to have considerable weight.

At various times in the past the volcanoes of the Philippines have caused destruction, and a severe earthquake especially in the Visayas and Mindanao usually arouses fears among the people of a volcanic outburst. The seismic data, both macroseismic and microseismic, enable us to definitely locate the earthquake, and even if it is in the vicinity of a volcano, we are able to judge whether or not it can be ascribed to volcanic action. Volcanic action is shallow and does not produce seismographic records at any considerable distance from its source.

A question which frequently arises is that of prediction. In the present state of seismology it is impossible to predict the time or place of an earthquake. Suggestions have been put forward to check movements on well-known and well defined fault lines but none of these have been followed up. It does not seem very practical except in a very few instances, such as the San Andreas fault near San Francisco. Even there, although commenced, it was not carried out consistently, if at all. The Japanese are doing considerable work in precise leveling over known fault areas to detect past and present movements but sufficient work has not yet been done to afford a basis for prediction. The so-called predictions of the Italian Bendandi which appear from time to time are worthless. He has caused so many false alarms that the Italian and some South American papers refuse to publish his material. He withdrew from the Italian Seismological Society because he received some advance information that he was to be expelled from it.

It is possible, that when more observations have been stored up and studied, some method of prediction may be discovered. What may be called modern seismology began only in the first decade of this century and when we consider the factors and difficulties involved in seismological work it is not at all surprising that we are still unable to predict earthquakes. Very few seismic stations have been operating continuously at a high standard of accuracy during the past 20 or 25 years. Even now, with a large increase in number, they are very unevenly distributed over the globe. Instrumental difficulties had to be overcome during this pioneer period. There was the disturbing factor of the world war and its effects; there is the necessity of cooperation between so many different nationalities. The number of severe earthquakes that afford material for world-wide study is very small. Lastly, we are dealing with terrestrial forces whose exact cause and nature are even yet only vaguely understood. To ask the seismologist in the present state of his science to predict earthquakes is asking the impossible. A work which we are continuously carrying on is that of cooperation with other observatories throughout the world. It is work of this nature which has enabled seismology to reveal knowledge of conditions in the interior of the earth which could not be learned by any other means. The deepest borings made by man are mere pin scratches compared to the diameter of the earth. But the elastic vibrations produced by earthquakes penetrate every portion of the earth and a world-wide system of seismic observatories records these vibrations when they come to the surface.

This is the only means now existing of obtaining what may be called direct physical contact with the interior of the earth. A comparative study of the records then reveals the path which has been followed by these waves and gives some idea of the condition and nature of the material through which they have passed. In this way Seismology has built up its concept of the structure of the earth. It is now generally believed that the earth has a metallic core of approximately 3500 kilometers radius, or something more than one-half of the interior of the earth. Over this there is a mantle of stony material having, possibly, one or more divisions. The outer crust of the earth has a thickness that is variously estimated at 35 to 50 kilometers in different places. The elasticity of this outer crust is not as high as that of the deeper mantle. This is only the barest outline of the modern concept of the structure of the earth as made known by Seismology. A detail account would consume too much time at present.

It is hoped that future meetings of the Scientific Society may afford opportunity for more extensive treatment and produce an increased interest in this branch of science.

NEW WOOD-ANDERSON SEISMOMETER AT CANISIUS COLLEGE

REV. JOHN P. DELANEY, S.J.

A new Wood-Anderson torsion seismometer has been installed at Canisius. The new instrument is of the long period type, capable under ideal conditions of maintaining a steady zero under an adjusted period of 12 seconds. But it has been found that ideal conditions are not to be had in the Canisius vault, and even an adjustment for a 10 second period was too unstable under local conditions of temperature variations and tilting. Satisfactory recording was finally obtained, but not until the period had been reduced to 6.5 seconds, an enormous sacrifice of sensitivify. Probably a longer period will be found workable after the instrument has settled and a cellotex housing constructed for it.

Even under conditions of limited sensitivity the new instrument will fill a long felt need. The necessity of at least one sensitive horizontal instrument has been evident since the installation of the new vertical Galitzin. The Galitzin record, with its impressive first preliminary phases, too often leaves the secondary in doubt. This failure of the secondary to record on the Galitzin implies no lack of sensitivity in the instrument but follows from the nature of the phase itself, carrying as it does, at least as arriving from distant quakes, little if any component of vertical motion.

The Wood-Anderson record is taken on the Galitzin recorder side by side with the Galitzin record, an eminently satisfactory arrangement. Its sensitivity toward the various phases as compared with that of the Galitzin will make an interesting study.

RECENT BOOKS

The books mentioned in this column are recommended by our Science Professors as suitable for the Science Libraries.

BIOLOGY

Heredity and Variation, by L. C. Dunn. 1932.

The Causes of Evolution, by J. B. S. Haldane. 1932.

The Scientific Basis of Evolution, by T. H. Morgan. 1932.

The Evolution of Human Behavior, by C. J. Warden. 1932.

The Invertebrata; A Manual for the Use of Students. 1932.

The Life of the Butterfly, by Friedrich Schnack. 1932.

CHEMISTRY

Experimental Chemistry for Colleges, by J. Allen Harris and William Ure. 1932. McGraw, Hill Book Co., New York.

An Introduction to Chemistry, by John Arrend Timm, Second Edition, 1932. McGraw, Hill Book Co., New York.

Elementary Qualitative Analysis, by J. H. Reedy, 1932. McGraw, Hill Book Co., New York.

Applied Colloid Chemistry, by Wilder D. Bancroft, 1932. McGraw, Hill Book Co., New York.

Metallurgy of White Metal Scrap, by Thews. 1932. D. Van Nostrand Co., Inc., New York.

Microscopic Character of Artificial Inorganic Solid Substances or Artificial Minerals, by Alexander N. Winchell, 1932. Second Edition. John Wiley & Sons, Inc., New York.

Physical Chemistry for Colleges, by E. B. Millard, Third Edition, 1932. McGraw, Hill Book Co., New York.

Principles of Organic Chemistry, by James F. Norris, Third Edition, 1932. McGraw, Hill Book Co., New York.

PHYSICS

The Outline of Atomic Physics, by Blackwood, Hutchisson, Ruark and Others, 1932. John Wiley & Sons, Inc., New York.

Atomic Energy States as Derived from the Analysis of Optical Spectra, by R. F. Bacher, Goudsmit, Samuel.

Recent Advances in Atomic Physics, 2 Vols., by Gaetano Castelfranchi. 1932.

Ein heitliche Theorie von Gravitation und Elektrizitat, by A. Einstein und W. Mayer, 1932.

The Physical Significance of the Quantum Theory, by V. F. Lenzen, 1932.

MATHEMATICS

Partial Differential Equations of Mathematical Physics, by Harry Bateman, 1932.

Related Mathematics, by W. L. Brown, 1932.

Mathematische Grundlagen der Quantenmechanik, Johann von Neuman, 1932.

BOOK REVIEWS

Scientific German

(1) *A German-English Technical and Scientific Dictionary*, by A. Webel.
E. P. Dutton & Co., 1930. xii, 887 pp.
$10.50. 7 x 10 inches.

(2) *Muret-Sanders Enzyklopadisches englisch-deutsches und deutsch-englisches Worterbuch*, Grosse Aufgabe, by Daniel Sanders, Immanuel Schmidt and Cornelis Stoffel.
Zweiter Teil, deutsch-englisch:
(Erste Halfte (A-J), xxiv, 8-1152 pp.
$23.00. (Zweite Halfte (K-Z), 1153-2368 pp.
Langenscheidtsche Verlagsbuschhandlung,
Bahnstrasse 28-30, Berlin-Schoneberg, 1901.

(3) *German Frequency Word Book*, by B. Q. Morgan, Professor of German, University of Wisconsin.
Macmillan, 1928. xiii, 87 pp.
6 x 9 inches.

(4) *German Idiom List*, by Edward F. Hauch, Professor in Hamilton College. Macmillan, 1929. xi, 98 pp.
6 x 9 inches.

(5) Knaurs *Konversations-Lexikon*
Verlag von Th. Knaur, Nachf., Berlin, 1932. 938 pp.
$1.25 (at Brentano's) 5 x 7 inches.

(1) Webel's dictionary is almost exclusively devoted to technical German, but emphasizes chemical and botanical terms. Many alternative meanings are given for each tabulated word, but without any examples or phrases illustrative of usage. An ingenious number system is pro-

vided throughout the dictionary for coding any word as half of a cabled code-word. The dictionary proper extends from page 1 to page 726. An excellent list of abbreviations occupies pp. 729-742, and a tabulation of signs and symbols pp. 743-744. A botanical section giving German equivalents for English and Latin plant names is found on pp. 745-887.

(2) Those of us who find difficulty with scientific German (and we are legion!), ought to have available the best reference books for the study of that language. The standard dictionary is unquestionably *Muret-Sanders* (nach der Methode Tuissaint-Langenscheidt), which is complete and accurate, with readable articles full of usage examples. Not the least virtue of Professor Langenscheidt's well-printed and well-bound series is the convenient provision in separate sections of tabulated conjugations, declensions, etc. The unabridged edition to which reference is made, comes in four volumes, two for the English-German part and two for the German-English part; and is quoted by Brentano's at $45.00 complete or $23.00 for either section separately.

(3) The booklets noted above are Volumes 9 and 10, respectively, of the Publications of the American and Canadian Committees on Modern Languages, sponsored by the Carnegie Corporation of New York. The *Frequency Word Book* is based on Kaeding's *Haufigkeitsworthterbuch der deutschen Sprache* (Berlin, 1898), which was derived from a count of no less than eleven million words in all fields of German literature. The mastery of 2402 words in the Basic List A brings with it the command of more than 6,000 alphabetically arranged words (List B), each of which has a total frequency of over one hundred in the enumeration. That would certainly suffice for the reading of any ordinary German text.

(4) The *Idiom List* tabulates 959 idioms in order of most frequent usage in one million or more running words scattered through sixty different texts; and indicates the number of texts in which each idiom is found. A second and alphabetical list also supplies the appropriate translations. A working knowledge of even one quarter of these would be an extremely valuable equipment for a student of German scientific literature.

(5) This modern one volume *Konversations-Lexikon* is a very interesting and amazingly low-priced encyclopedic dictionary (similar to the French *Petit Larousse Illustre*) containing some 35,000 terms, 2600 illustrations, 70 colored tables and maps, and 115 statistical graphs. Besides being a very complete and handy reference work for historical, technical, geographical, biographical, industrial and social terms, it makes a fine introduction to present day German for scientific readers. To see how this dictionary can be used to supplement less modern works, confer the concise, clear and accurate articles and diagrams on:
Bildelgraphie (phototelegraphy and television), Elektrizitat, Film, Tonfilm (talkies), Aufnahme im Film-Atelier, Wiedergabe im Licht-

Spielhaus, Geologische Formationen, Trickverfahren im Micky Haus Film (!), Optik, Photographie, Polarisation, Radiotechnik, Rechenmaschine, Rundfunk (broadcasting), Sterne, Stickstoffgewinnung aus der Luft (Haber-Bosch process), Winkel, Zeitzonenkarte.

Applied Colloid Chemistry. Wilder D. Bancroft, World War Memorial Professor of Physical Chemistry at Cornell University. Third edition. McGraw-Hill Book Co., Inc., New York and London, 1932. ix 544 pp. 24 Figs. 14 x 20.5 cm. $4.00.

This edition of Professor Bancroft's well-known book appears eleven years after the first edition. (For review of the second edition of this book see J. Chemistry Educ., 3, 1350, Nov., 1926). The arrangement of subject matter is much the same as in the two previous works but there is incorporation of new material throughout the entire book. The chapter headings are as follows: adsorption of gas or vapor by solid; chemical reactions; adsorption of vapor by liquid and of liquid and solid by solid and liquid; adsorption from solution; surface tension-Brownian movements; coalescence; preparation of colloidal solutions; properties of colloidal solutions; stability of colloidal solutions; gelatinous precipitates and jellies; emulsions and foams; non-aqueous colloidal solutions; fog; smoke; gases and solids in solids; thickness of surface films. In this edition the literature references, which appeared as footnotes in the previous editions, have all been collected in a single section at the back of the book and there they are arranged in alphabetical order by authors.

The book, as stated by the author, was written "for those who are interested in colloid chemistry as chemistry rather than as mathematical physics." In this the author has succeeded beyond expectations. Here is collected, in a systematic fashion, the vast amount of knowledge about colloids which exists today. Professor Bancroft presents this information in such a simple yet stimulating fashion that the book is entertaining as well as readiable. On almost every page one finds something that excites his curiosity. In fact so many research problems are suggested directly or indirectly that one might almost consider this work a source book for new research ideas. Probably no other author in the field of colloid chemistry has such a wide general knowledge of the subject coupled with the stability to present it in so concise, yet stimulating, a manner.

This book may certainly be said to fulfill the author's purpose in writing it. In the field of chemical education this volume should find an important place as a reference work. It is doubtful that, as a textbook, it will find widespread use and it is not likely that it was intended as such. However, the third edition has been brought up to date with references to work which was published as late as the first months of 1932. As a result this edition may be expected to occupy the same high place in the esteem of those chemists interested in the fields of colloid chemistry as did the previous editions.

L. H. R.

Applied X-Rays. George L. Clark, Professor of Chemistry, University of Illinois. Second edition. McGraw-Hill Book Co., Inc., New York City, 1932. xiv 470 pp. 239 Figs. 15 x 23 cm. $5.00.

The first edition of this book was intended by its author as a missionary, telling of the uses to which X-rays could be put. It fulfilled that purpose admirably. Now that the pioneer missionary work has been so successfully done, the author is justified in feeling that the need at present is for an elementary textbook on the subject. The second edition of "Applied X-Rays" is therefore really a new book, not merely a revision. It is divided into two sections. The first consisting of 170 pages, deals with the physics of X-rays, X-ray tubes and circuits, radiography, and the more physical applications of X-rays in chemistry and biology. The second section, consisting of 291 pages, deals with the use of X-rays in crystal analysis. The first part of this section reviews briefly the necessary basic knowledge of crystallography, and the diffraction of X-rays by crystals. This is followed by an outline of the experimental methods of crystal analysis and the interpretation of the diffraction data. The rest of the second section of the book is devoted to a series of resumes of the results of crystal analysis. These results are classified as follows; crystal structure data for elements and inorganic compounds, generalizations in inorganic chemistry, structure of alloys, structure of organic compounds, grain size, orientation, industrial metallurgical problems, liquids and colloids, and polymerized organic materials.

The result is a book well adapted to college seniors who have had a good basic training in physics and chemistry, and in physical chemistry and chemical physics. It could be used successfully in classes composed of seniors in the standard college curricula in physics, physical chemistry and chemical physics, or metallurgy. It is not intended to be of graduate student grade, but graduate students ought to buy it and use it for private introductory reading in preparation for a graduate course in crystal structure and its applications.

All teachers of chemistry and metallurgy will find it a valuable addition to their private libraries. It is safe to say that those teachers who read this book will show the effects in their lectures to their students.

W. P. D.

NEWS ITEMS

Weston College, Weston, Mass.,
January 31, 1933.

Reverend Richard B. Schmitt, S.J., Editor,
Bulletin of the American Association of Jesuit Scientists,
Loyola College, Baltimore, Maryland.

Dear Father Editor;—

I was absent from Weston College for quite awhile during the fall and so did not receive my copies of the Bulletin until lately. While looking through the September issue, I re-read among the resolutions the message of sympathy which our Association voted to send to me on the occasion of my sojourn in the hospital last summer. The Secretary, Mr. Lincoln J. Walsh, S.J., conveyed the message to me in due time and I acknowledged it.

It has occurred to me however that it might be fitting for me also to avail myself of the Bulletin to express to the Association my gratitude and appreciation, instead of waiting until the next meeting when the Secretary makes his report. I desire therefore, to thank all the Members *ex corde* for their charity and thoughtfulness. I was much cheered by their sympathy. May God reward them all.

With best wishes,

Sincerely in Our Lord,
HENRY M. BROCK, S.J.

MANILA OBSERVATORY, Philippine Islands. Rev. Charles E. Deppermann, S.J., has been appointed Assistant Director of the Weather Bureau. The appointment was made on December 20th by the Governor General, Col. Theodore Roosevelt, Jr. Father Deppermann is in charge of the Meteorological Department.

BOSTON COLLEGE, Physics Department.—A Seminar is held in the Physics Lecture-room every other Monday.

(As almost all the members present are Juniors and Seniors, the papers help to clarify concepts used in Philosophy and Physics.)

The first paper gave the facts and mathematical conclusions on the "ATOMIC NATURE OF ELECTRICITY" and then discussed the theories and the difficulties from the theory of "MATTER AND FORM".

The second paper from its nature was mathematical but the discussion brought out the facts about "THE MOLECULAR THEORY and EXTENSION".

The third paper "THE QUANTUM THEORY and FREE WILL", explained facts, then the theories, and used the new book of Max Planck "Where is Science going" to refute those who denied free will and causation.

The fourth paper caused a great battle, but when the debate from the floor was over, many of the concepts about "RELATIVITY and IDEALISM" were a little clearer.

The papers to follow are on subjects as "Wave Mechanics"; "Ionization by Collision", "The Compton Effect"; "The Nature of X-Rays", etc. One member is appointed to find the difficulties in the Philosophy notes and bring them to the seminar. The Seniors in the B.S. PHYSICS course have been preparing the papers and have found the work very interesting as they have had enough Physics and Philosophy to work out the problems.

LOYOLA COLLEGE, Baltimore, Md. Chemistry Department. On February 14, Dr. Charles S. Piggott of the Geophysical Laboratory, Carnegie Institution, Washington, D. C., delivered a lecture to the Loyola Chemists' Club on the subject: "Recent Investigations of Radioactive Isotopes". Dr. Piggott claims fifteen isotopes of lead and a corresponding number in the other radio-active substances. He will sojourn to Cambridge, England, to present the results of his researches on these isotopes.

GEORGETOWN UNIVERSITY.—Astronomical Observatory.—A program for photographic study of long and short period variable stars in the Mascart and other areas, has been instituted at the Georgetown College Observatory.

During the past month, the Assistant Director of the Riverview College Observatory, Sydney, Australia, has been studying celestial photography under Father Paul A. McNally, S.J., and seismology under Father Frederick W. Sohon, S.J.

Among our distinguished visitors was Abbe Georges LeMaitre of Louvain. The text adopted for the general descriptive astronomy course for undergraduates is Forest Ray Moulton's *Astronomy* (Macmillan, 1932). The widespread interest in the Georgetown eclipse plates still continues. Dr. James Stokley's eclipse projector (described in the *Journal of the Optical Society of America*, Vol. 22, No. 5, May 1932) designed by Bausch and Lomb for the Franklin Institute Museum in Philadelphia, will use one of our colored slides for the total phase. A six by three foot enlargement will be put on permanent display by Dr. Philip Fox in the museum of the Adler Planetarium in Chicago, which is to be the astronomical center for the *Century of Progress* Exposition. Prof. Frank Schlesinger of Yale, President of the International Astronomical Union, recently wrote a fine letter congratulating the Director on one of the very best coronal pictures ever taken. Dr. A. S. Mitchell, Director of the Leander McCormick Observatory and author of the standard text *Eclipses of the Sun*, has asked permission to reproduce the Georgetown eclipse plates in the fourth edition of his work to be published this spring. The American Association for the Advancement of Science, at its Atlantic City meeting during the Christmas holidays, displayed a huge unretouched enlargement of one of the Georgetown plates, which attracted unstinted praise from America's leading astronomers. Among others, Dr. Walter S. Adams, Director of the Mount Wilson Observatory, strongly urged that Georgetown send an expedition to Laol Island, one of the Losap group in the Pacific, for the eclipse of February 14, 1934, using the same technique that was so unusually successful on August 31, 1932.

GEORGETOWN UNIVERSITY.—Medical School.—The Kober Day Celebration will be held this year on Tuesday, March twenty-eighth, at 8 P. M., in Gaston Hall. Under the provisions of the Kober Foundation, on the twenty-eighth of each March in commemoration of the birthday of Dr. George M. Kober, formerly Dean of the Georgetown University School of Medicine, a medal is awarded and a lecture delivered. The medal this year will be awarded to Dr. Alfred Newton Richards, Professor of Pharmacology at the University of Pennsylvania. Dr. Richards has made a specialty of medical research regarding the Kidneys, and in acknowledgment of his contributions to science in this field the medal has been awarded by the Association of American Physicians. Due to special circumstances this year the actual presentation of the medal will take place on May ninth instead of March the twenty-eighth. The presentation will be made at the annual meeting of the Association of American Physicians in Washington.

The Kober lecture will be delivered this year by Dr. R. E. Dyer of the United States Public Health Service. Under the terms of the Foundation the choice this year was made by the Association of Military Surgeons of the United States, and they selected Dr. Dyer. Dr. Dyer has made very valuable contributions to the epidemiology of typhus fever in this country and has demonstrated that, like plague, it is a rat-borne disease transmitted to human beings by the rat flea. He has also made the startling discovery that a severe and often fatal form of typhus fever which has occurred in rural districts in the Eastern United States, is a form of Rocky Mountain spotted fever transmitted by infected ticks. Dr. Dyer has just recovered from an attack of typhus with which he was infected in his laboratory in the process of these investigations.

FORDHAM UNIVERSITY—CHEMISTRY DEPARTMENT

Program of Seminars

Scholastic Year 1932-1933

1. The Chemistry of Fermentation—Dr. A. Schwartz—Schwartz Laboratories.
2. Chemistry of Vitamin B_1—Mr. John J. Thornton—Fordham.
3. Certain Aspects of Sulfur Metabolism—Mr. Jacob A. Stekol—Fordham.
4. Chemistry of Vitamin B_2—Mr. Raymond M. Wall—Fordham.

5. Industrial Preparation and Applications of Irradiated Yeast—Dr. C. A. Smith—Standard Brands, Inc.
6. The International Physiological Congress—Rome 1932—Dr. Benjamin Harrow—City College.
7. Glycuronic Acid—Dr. A. J. Quick—Fifth Avenue Hospital.
8. Sulful Metabolism—Dr. Withrow Morse—Medical Center.
9. Hydrolysis and Ammonolysis—Mr. William Breckstone—Fordham.
10. Contour Maps of Chemical Reactions—Dr. Hugh S. Taylor—Princeton University.
11. The Chemistry of Vitamin A—Mr. Douglas Hennessy—Fordham.
12. Action of Yeast on Isomeric Sugars—Dr. Harry Sobotka—Mt. Sinai Hospital.

BOSTON COLLEGE.—Chemistry Department.—Father Sullivan, Dean of the Department of Chemistry, member of the Board of Control of the Nucleus, which is the official organ of the Northeastern Section of the American Chemical Society, has been appointed a member of the Committee on Moving Pictures, to supply entertainment at the monthly meetings of the Northeastern Section of the American Chemical Society.

This committee has been functioning for two months to date and its work has apparently been received with great favor by the local members and guests.

Chemical Seminars have been unusually successful this year and topics presented have been prepared with such care by the men appointed that a large influx of chemically minded students has been the result. Some of the topics which met with unexpected approval were: Ozone, by Mr. John J. Scanlon, M.S., '33; Materials of Construction in Electrochemistry, by Mr. C. J. Nugent, M.S., '33; and the Chemical Effect of Alpha-Particles and Electrons, by Mr. Robert J. Jordan, B.S., '33, who happens to be captain of this year's track team and an exceptional student.

As part of the drive for new members in the Northeastern Section of the American Chemical Society, two of the assistants at Boston College have responded with applications for membership; one as a student member and the other as a full-time member.

The advantages both from literature received and from contacts made as part of such a membership have been the predominant appeal to those who wish to become members.

On December 15, 1932, at 7:30 P. M., Mr. John T. Ryan, Professor of Inorganic Chemistry at Boston College, delivered a radio address over Station WNAC at Boston, Massachusetts, on the subject of "Petroleum".

Mr. Ryan discussed the discovery and early uses of petroleum and also its various uses today.

On December 29, 1932, at 7:30 P. M., Dr. David C. O'Donnell, Professor of Organic Chemistry at Boston College, delivered a radio address over Station WNAC at Boston, Massachusetts, on the subject of "Acetic Acid".

Dr. O'Donnell discussed the uses of acetic acid and the numerous attempts to extract acetic acid from various materials when the supply ran short during the World War.

WESTON COLLEGE. Rev. Henry M. Brock after a long convalescence has resumed teaching. He is giving a course in calculus to the special science students in second year philosophy, and a course in advanced physics to a group of students in third year philosophy.

SCIENCE ABSTRACTS, No. 10, 1932.—Thunderstorm Problem proposed by Rev. Charles E. Deppermann, Manila Observatory. A description is given of the phenomena during thunderstorms at Manila. Lightning only occurred when the cumulus nimbus was capped at cirrus heights; these caps may be grouped under five types. The rapid development of large initial potential and the effect of the different kinds of clouds on the potential are mentioned. A comparison is made between the series of events in a typhoon squall and an ordinary storm.

REGIS HIGH SCHOOL PASTEUR CHEMISTRY SOCIETY

The Society opened its first meeting of the year in the latter part of October. After the election of officers, it was decided that meetings were to be held once every week. The Moderator, Mr. Thornton, then presented a plan of the schedule for the year.

The second meeting featured a talk "The Life of Luis Pasteur" by the president of the Society. At the next seven meetings the following papers were read and discussed by members: "Peace-time Use of Some Chemical Warfare Agents"; "Gas Available for Refrigerants"; "The Manufacture of Rubber"; "Sulfur and Purities"; "Household Colloids", and "Glues and Gelatins".

On January the eighteenth a very interesting and instructive talk on "The Chemistry of Sugar" was given to the members by Mr. Alfred McGuinn, S.J., of Fordham University. At a very near date, Father Francis Power, S.J., of the Chemistry Department of Fordham is to speak to the members of the Society.

Plans have been completed for a visit to the shops and labratories of the Polytechnic Institute on February 17th. There is also to be a visit to the labratories in Chemistry Hall at Fordham, and to the Borden Milk Products Company's labratories and ice plant in Brooklyn within a few weeks.

The Regis Pasteur Chemistry Society is scheduled to hold its annual chemistry demonstration on May 2nd. Plans are already under way for this important event which is becoming more popular every year.