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# Bulletin of the American Association of Jesuit Scientists

EASTERN STATES DIVISION

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## General Articles

### AMNIOTIC FLUID AND BAPTISM

REV. ALBERT F. MCGUINN, S.J.

The following data on the water content of various liquids was gathered from reliable textbooks and journals, in order to provide background for answering a specific question: can the amniotic fluid be considered matter for the sacrament of baptism in case of necessity? The author has given his opinion privately and post factum, but he would like to present for consideration of moralists the two cases which occasioned the question.

Case I. In the middle of the night, in very weakened condition, without any possibility of calling help, Mrs. A gave birth to an apparently stillborn child that might be alive. Her first thought was to baptize the child, but she was unable to get water. Feeling the moisture on the child, and reasoning that it was the action of her body that caused the rupture of the amniotic sac, making the fluid flow, she pronounced the words of baptism. Was the baptism valid?

Case II. A woman mission doctor in the heart of Africa is very zealous for the baptism of infants, even to the extent of using water in a hypodermic syringe and inserting it through the abdominal wall to come in contact with the head of the fetus, when it is evident that the child can not be delivered alive. Considering the watery nature of the liquor (amniotic fluid) in comparison with the chemical composition of sea water, she writes: "It occurred to me to wonder if the liquor was not itself suitable matter, because it is more like water than several things which in case of necessity could be used, some sea and lake waters for example." If this liquor were suitable matter, she could manually tilt the infant slightly while pronouncing the words, and thus confer baptism "in utero" when it was the only possibility. Is such a baptism valid?

#### DATA OF CHEMICAL ANALYSIS

<i>Liquid</i>	<i>% H<sub>2</sub>O by Weight</i>
Blood	50
Urine	96
Milk	87.5
Saliva	99.3
Sweat	98.8
Ocean Water	96.5
Water of Dead Sea	77.2

Water of Great Salt Lake	77
Tap Water (1200 ppm solids)	99.88
Gastric Juice	99.4
Pancreatic Juice	97.6
*Amniotic Fluid	98.8
Soft Drinks	90

Note: These are average figures, but the variation from the average would not make a significant difference for the present problem.

If the above analytical data is compared with the list of fluids which are classed by the moralists as certainly valid, certainly invalid, and probably valid, it will be evident that percentage of water is not the deciding factor. Sea water has been classed as certainly valid, saliva as certainly invalid. It is difficult to find the criteria for such classification other than examples given by competent moralists, but it seems that percentage of  $H_2O$  is ruled out as a criterion. The water solutions commonly listed as certainly valid vary widely in chemical composition, but they are all such as you would consider suitable for washing yourself, and according to common acceptance are called water. A 50-50 mixture of water and alcohol provides a cleansing and refreshing bath, but people call it an alcohol bath, and it would hardly be considered as matter for the sacrament. Hence, capacity for washing is not sufficient,—it must be a material that is commonly called water. When saliva containing 99.3%  $H_2O$  is classified as certainly invalid (despite the fact that kitty uses it for washing, and some lens experts use it for putting the final touch on a microscope lens), it would seem that the source of the water solution is one of the main criteria in judging its validity as matter for the sacrament. It is a moral judgment that involves not merely chemical analysis, but common estimation and due respect for the sacrament, and it is inevitable that borderline examples will occur where the question of "decentia" is debatable. Distinctions are made between tea and light tea, soup and light soup etc. The case for the validity of amniotic fluid would probably be decided on this basis of "decentia".

The nature and function of the amniotic fluid is discussed in textbooks on human embryology. Theories of its formation differ but it seems to be generally agreed that its main function is mechanical, in providing a cushion for the developing fetus. It is a very dilute water solution having a very pale yellow tint and a slight cloudiness. The presence of small amounts of urea and uric acid indicate that it also serves to remove some of the waste products of metabolism excreted by the fetal kidney. However, the excretory function of the amniotic fluid is minor, and it would be erroneous to consider it as fetal urine.\*

\*D. Uyeno, *Journal of Biological Chemistry* 1919, 37, 83.

The author would like to emphasize at this point that the problem concerns only the possibility of classifying amniotic fluid as probably valid matter, the use of which would be licit and obligatory as a last resort.

In arriving at a solution, the following criteria are respectfully suggested as a summary of the above analysis:

1. The material must be at least 75% water by chemical analysis.

2. It must be such in appearance that, by common estimation, it would be called water.

3. It must have such properties as would make it suitable material for cleansing.

4. If it fulfills the previous points, its source must be such that, in the opinion of moralists, the sacrament is not subjected to indignity, even in extreme necessity.

In conclusion the author would like to explain that his interest in this question was aroused about five years ago, when Case I was presented to him by a moralist who wished to have the opinion of a biochemist. Recent decision to write up the case led the author to another moralist who had met the same question in Case II about three years ago. According to our knowledge, this question has never been discussed. The opinions of a fervent Catholic mother and a zealous Catholic missionary doctor seemed sufficient reason for presenting the problem to the moralists.

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## NOTES ON THE USE AND CONVERSION OF WAR SURPLUS FOR LABORATORIES

REV. BERNARD A. FIEKERS, S.J.

Dynamotors have been generally available and are to be found in surplus collections either separately as replacement parts, or mounted in radio receivers from the services. It has been found with one particular model that its input voltage could be varied up to the usual 28 volts so that its 110 volt output could undergo a variation from 400 to its usual 800 cycles.

Dynamotors can also be rebuilt, economically and in quantity, into universal motors. The Heath Company of Benton Harbor, Mich., advertises its no. 230 "Home Workshop Grinder Kit", a dynamotor in which the purchaser is to make simple changes. DM-36-C is one of its service designations. The recommended changes include: reversal of the armature so that brush contacts are exchanged at the high voltage and the low voltage extremities. A 110 volt A.C. line can then be led into the high voltage brush contacts. The low voltage brush contacts are neglected. The stator is wired in parallel with the armature. The shaft is drilled on a lathe and extended. By using

*(Continued on page 85)*

# Biology

## BIOLUMINESCENCE

WILLIAM D. SULLIVAN, S.J.

The strange phenomenon of light-producing fireflies and glowworms is a fact well-known to most nature observers. The fiery seas, too, are known not to be mere figments of the imagination of early explorers, for they also can be seen today in the various seas of the world. However, the number of different species of organisms which are luminescent is not so well known, nor is the chemistry of bioluminescence so apparent as to be evident to the ordinary observer.

The firefly and the glowworm are by no means the only organisms capable of producing light. Protozoa, Coelenterates, Annelids, Echinoderms, Mollusks, and, perhaps, other invertebrates, not yet discovered, also produce light. Among the vertebrates, fishes and elasmobranchs produce light. Though very few plants produce light, some are typically bioluminescent.

First of all, these organisms are not phosphorescent, because phosphorescent light requires a previous exposure to light of some sort. The hands and numbers of a clock glow in the dark only after a source of light has been directed on them for some time. The length of time during which they phosphoresce depends on the length of time they have been exposed to light. The hands and numbers of the clock will not glow if the clock has remained in a dark room for a considerable time. Light-producing organisms, on the other hand, do not need and are not dependent in any way on illumination. Of themselves, they produce light. Bioluminescent fish dwell in the very depths of the ocean, where no light ever penetrates. Luminous bacteria have been known to exist in otherwise complete darkness for years.

The light produced by these organisms is chemiluminescence, i.e. due to a chemical reaction, and though it is associated with living organisms and hence called bioluminescence, it is independent of life itself.

Light, arising from damp, dead wood, has been known as far back as the days of Aristotle and Pleni. They wrote about luminescent dead fish and decaying meat. It was not until 1742, however, that Baker discovered the luminescence of dead fish to have its source, not from the fish itself, but from tiny "animalcules" infesting the dead body. Hellar, in 1854, identified these "animalcules" as *Sarcina noctiluca*, a cystoflagellate. In 1875, Philque

inoculated a bacteria medium with small luminous bits of dead fish and noted the rapid increase of the colonies of bacteria. He concluded from his experiments that light from all dead material is due to luminous bacteria, the causative agent of light.

Many attempts have been made to explain the luminescence of the fiery seas. Papin, in 1647, claimed that it was due to the striking of the salt granules against each other. Benjamin Franklin, in 1740, thought it was due to the splitting of the salt and water molecules. In 1763, Baker gave the more acceptable explanation when he said that it was due to the protozoan *Noctiluca*. It may also be due to the luminous jellyfish, *Mnemiopsis*, a beautiful member of the Ctenophores, found abundantly in the North Atlantic. The *Mnemiopsis*, when disturbed, flashes its light off and on.

All in all, there are about forty orders of animal forms which produce light. In the plant kingdom, bacteria and fungi only produce light. There is no pattern of distribution among the luminescent organisms, and there is no evidence for evolution among those organisms which do produce light. Luminescence is, however, much more widespread among the Coelenterates than among any other phylum. In general, luminescent organisms seem to have been picked at random with no explicit manifestation of rhyme or reason for the choice. This much alone has been discovered: all luminescent organisms are either marine or terrestrial; there are very few fresh water bacteria and only one glowworm, the *Arachmocampa luminosa*, which is the larval stage of a small flying insect, having hatched from an egg which is laid on the ceilings of some caves. Moths and midges are attracted by the light from these glowworms and they become entangled in the threads spun by the worm. The worm reels in the thread and devours both the thread and the insect.

There are many species of luminescent bacteria. These bacteria are very much like other bacteria in every way but in their capacity to produce light. Fabricus, as early as 1592, noted luminous mutton; Boyle, in 1672, noted luminous veal, pork, chicken; and Poullinus, in 1707, observed luminous eggs. Luminous human cadavers were also noted; neglected wounds of human beings were noted time and again to glow with a steady light. The literature has also mentioned the frequent presence of luminous bacteria in urine. The source of light for all these is now known to be due to the presence of luminous bacteria.

Luminous bacteria are very easily cultured. Though many of the higher animals have been reported to be luminescent, such as the sand-flies, caterpillars and other insects, it is now known that in the greater part of these cases the light produced is due to the bacteria attached to them. According to Pierantoni and Zirpolo, a good number of these cases are due to a symbiotic relationship existing between the animal and the bacteria infesting them. It has been shown that luminous bacteria inoculated in certain of the



higher animals will survive but will not luminesce. This ability to produce light, therefore, by the bacteria is limited to certain species of animals. In the case of a certain Japanese fresh-water shrimp, the bacteria attached to it will glow, but if the same bacteria are inoculated into fish or mammals, the bacteria will die due to the toxic effect produced by the host. Therefore luminous bacteria will glow under some conditions, but will not glow under other conditions. Two examples of symbiosis exist between the *Anomalops katoptron* and the *Photoblepharon palpebratus* and the bacteria which exist on them. The *Photoblepharon* have a fold of black tissue which may be pulled down, as a stage curtain is lowered, covering a cavity below the eye and filled with glowing bacteria, thereby cutting off the light from within. The *Anomalops* have a similar structure, except, the covering of the cavity gives the appearance of being attached to hinges which can be flipped open or shut at will. Some of these luminous fishes are equipped with reflectors and even lenses.

Luminous bacteria are characterized by a continued glow of light emanating from them. Hence when any organism produces light, not in flashes, but continuously, this light may be safely surmized to come from bacteria existing on the animal. When intermittent flashes of light are noted, the light may be said to arise from a light-producing organ within the animal itself.

There are no particular group of fungi which are characterized by their capacity to produce light. Old stumps of trees and rotten wood have often been noted to produce light. Parasitic fungi within the bark of the tree cause this luminescence. The light is seen to emanate from the mycelium of the tree as well as from that part of the fungi which may be exposed to the air.

Among the protozoa, the flagellates and the Radiolaria are commonly cited in the literature to be luminescent. No fresh-water flagellates have been observed with the capacity to produce light. The *Noctiluca* is, perhaps, most often described as typical of the luminescent protozoa. Though they have not been cultured, as far as the author is aware, in any laboratory, yet these animals show excellent manifestations of bioluminescence. According to Heilbrunn, bioluminescence among the sponges is rare, and most cases reported are due to other luminous organisms existing within the sponges. It is extremely difficult to tell whether the light arises from the sponges, themselves, or whether it arises from organisms within the various canals of the sponges. There are no reported cases of luminescent Porifera. In the Coelenterates bioluminescence is very well manifested. Geographically, they are widely distributed, and even the waters of Alaska contain luminescent medusae, The *Palagia noctiluca*, a large jellyfish, common in the Mediterranean, luminesces on stimulation, and the whole surface of the umbrella as well as the tentacles light up. This is said to be due to the nerve-

net spread throughout the jellyfish. The luminous material in these animals is in the form of granules, which, when broken down, give off light. These granules are chemical in nature and lie in a mucous material. The mucous material can be dried, rewet and again produce light. The light-producing organs in these animals are, therefore, resistant to drying. Many forms of the Ctenophores produce light: the *Mnemiopsis*, mentioned above and found in and about the waters of Wood's Hole, the *Pleurobrachia pileus*, the *Cystus*, or *Venus Girdle* as it is sometimes called, the *Beroë*, and numerous others. Dahlgren, in 1915, described the light as coming from cells along the canals of the Ctenophores. As yet no luminous secretions have been noted to come from these animals. No report has been made of the bioluminescence in the Platyhelminthes or flatworms. A few questionable reports have been handed down on the presence of luminescent Nematelminthes. As early as 1682 certain earthworms among the Coelenterates were reported to luminesce. The *Chaetopterus*, a very elaborate marine worm, is a very good example of a luminous Annelid. In 1884, Will described the light coming from this worm. Light originates from the large epithelial cells. These cells contain granules, which, when broken down, produce light. Hasama, in 1943, reported that electrical, chemical, mechanical and also osmotic stimuli could break down these granules and thereby cause luminescence throughout the entire body of the animal. The larvae of this worm will also glow if stimulated by any of the above mentioned stimuli. Among the Crustaceans, the *Cyprinida* is the most characteristic of all light-producing animals. It is very useful as an experimental organism. The luminous sea spider from the Indian Ocean, *Colossendus gigas*, a pycnogonida, produces a greenish-blue light from the under side of its legs. This spider measures about twenty inches across. The *Pholas dactylus*, a Mollusk, has been used along with the *Cyprinida* for chemical discoveries made on chemiluminescence. The Cephalopods which produce light are found largely among the squids, and there is only one group of the Echinoderms, so far reported, which are luminescent, and they are the brittle star-fish, *Ophioderma brevispinum*. This animal gives off no luminous secretion, but has special glands which produce light. Among the Chordates, the *Balanoglossus* secretes luminous slime which can be dried, rewet and will again luminesce. Though there is some doubt about the luminescent Tunicates, some of the literature affirms the presence of luminescence in these animals. Among the fishes, other than those already mentioned, there are some deep sea forms which have long, wand-like structures which light up. As for those animals above the fishes there are no valid cases of organisms which produce light.

The second fact which is not so commonly known about these luminous animals and plants is the chemical explanation of luminescence. Various chemical experiments have been performed on

the different animals to establish the chemical nature of the light produced. In 1773 Reamur collected slime from the *Pbolas dactylus*, dried it, rewet it and light was produced. Spallanzani in 1794, found that the slime from many other bioluminescent animals acted in like manner. The most important, and perhaps the most spectacular experimental work, was performed by Harvey and Dubois.

Very early investigators claimed that oxygen was not necessary for luminescence in luminous organisms, but both Harvey and Dubois proved that very minute quantities of oxygen are necessary. They claimed that, first of all, it is almost impossible to get rid of the last traces of oxygen from the medium. Hence the early workers were most likely wrong in their findings. By passing gas over red hot copper so as to remove all oxygen, Harvey and Morrison showed that luminescent bacteria require as a minimum concentration of oxygen necessary, one part oxygen to about 143,000 parts of hydrogen for visible luminescence. According to Heilbrunn, therefore, this corresponds to 1 gm. of oxygen, by weight, dissolved in 3,700,000,000 Gm. of sea-water. Luminous organisms, as well as extracts from luminous cells or luminous secretions do not produce light when all the oxygen is removed from the medium. This, too, has exceptions, inasmuch as the jellyfish, *Pelagia*, will luminesce in the absence of oxygen. Harvey concluded from this that either dissolved oxygen is not necessary for chemiluminescence or that the photogenic material carries oxygen along with it. The latter, Harvey thinks, is the more acceptable theory.

Dubois, in 1887, was the first to give a clear explanation of the chemistry of bioluminescence. He made hot-and-cold-water extracts of the luminous organs of *Pbolas dactylus*. The hot-water extract he showed to be non-luminous, while the cold-water extract was luminous for a short time and then the light disappeared. At this point he took the hot-water extract, which was non-luminous, mixed it with the cold-water extract, and light was produced again. From this experiment Dubois concluded that in the hot-water extract there is an enzyme, called luciferase, which is heat labile, but the extract still contains a substance called luciferin which is the substrate on which luciferase acts to produce light. In the cold-water extract there is luciferase which acts on the luciferin until it is used up or converted to oxyluciferin. This explains why, in the cold-water extract, the light went on for a short time and then went out. When the two were mixed together, the luciferase (an enzyme still active from the cold-water extract), acted on the luciferin in the hot-water extract. Light, therefore, is due to the action of the enzyme, luciferase, on its substrate, luciferin.

Harvey, in 1924, mixed the luciferase from one organism and the luciferin from another, and since the two animals were not closely related, no light was produced. From two closely related

organisms, producing light of two different colors, Harvey extracted the luciferase and the luciferin, and found by mixing these two substances that the color of the light is determined by the luciferase.

As to the chemical nature of these two substances, the opinions differ. Luciferin is definitely not a proteose, because of its extremely low molecular weight and because it does not behave as such; it does not form antibodies. Kanda, in 1932, extracted a crystalline substance from *Cyprinida* which he claimed was a phospholipid. Anderson, in 1936, thought it was a polyhydroxybenzine. Luciferase acts both like an enzyme and a protein. Harvey claims that luciferase might be a protein because of the formation of antiluciferase after the enzyme had been injected into the rabbit. Also luciferase is obtained in concentrated forms by protein methods.

The formula for the production of light in the *Cyprinida* may be summarized as follows:

1. Luciferin +  $\frac{1}{2}$  oxygen  $\longrightarrow$  excited oxidized luciferin water.
2. Excited oxidized luciferin + luciferase  $\longrightarrow$  oxidized luciferin + excited luciferase.
3. Excited luciferase  $\longrightarrow$  luciferase + energy (light).

The energy produced is apparently all contained in the form of light. There is absolutely no heat produced whatsoever. In the ordinary electric bulb, the energy produced is approximately 5% light and 95% heat; in the luminous extracts of *Cyprinida* the energy produced is approximately 100% light. J. P. Morgan and Rockefeller himself would be poor men compared to that man who finds it possible to invent such a system of light for the ordinary home.

Note:

Subsequent to the writing of this article the author received a 55 page article on Bioluminescence, printed in the 'Annals of the New York Academy of Sciences', Vol. XLIX, pgs. 327-482. In this article the five following topics are treated at great length by five noted authorities on bioluminescence.

1. A general survey of bioluminescence. By E. Newton Harvey.
2. Chemiluminescence in aqueous solutions. By Rubert S. Anderson.
3. The chemistry of *Cyprinida* luciferin. By Aurin M. Chase.
4. The fundamental action of pressure, temperature, and drugs on enzymes, as revealed by bacterial luminescence, By Frank H. Johnson and Henry Eyring.
5. The anatomy and physiology of the light organ in fireflies. By John B. Buck.

These five articles are a sum total of the work which has been done, to date, on bioluminescent organisms.

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#### PREFERRED SYNTHESSES IN ORGANIC CHEMISTRY

REV. BERNARD A. FIEKERS, S. J.

Elsewhere in this issue the author presents a study of most of the derivatives of benzene that are listed in the first twenty-eight volumes of *Organic Syntheses*. To it a bibliography of the various syntheses is appended. This seems to be a fair sample of teaching material that can be found in this ever growing work. It is very difficult for the instructor to keep abreast of the literature for all of the matter he may be called upon to teach. He may be pessimistic about the textbooks at times and suspect them of copying adroitly the matter of their predecessors for the last one hundred years or so—along with the errors of course! On turning to the literature he may become involved in long discussions that include every by-product of a reaction down to the last odor. He finds outright contradictions in works like *Beilstein*. In much of the modern literature, such as the new series of four volumes of *Organic Reactions* by Roger Adams et al. and in the set of *Organic Syntheses* mentioned, he can generally find tested and checked methods, warm from the laboratory, to support his teachings. We once referred our students to the "practical art" of the organic science, and made great gestures to the literature. Today we can call upon "preferred" methods. Before sets of this kind grow too large, it would be well to become as familiar with them as possible. For then it will only be a matter of catching up on the latest each year.

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(Continued from page 78)

a 0-500 ohm, 50 watt resistance in series with the load, variable speed can be had. The case is completely enclosed and can be sealed off in order to make it explosion proof as a laboratory stirrer. Indeed, it seems to have been designed to run somewhat hot. Thus it can be used as a laboratory stirrer with liquids, that are not too viscous, over a period of some hours. Arrangement can easily be made for attachment to a clamp holder by using a length of quarter inch, soft iron pipe, bent at right angles, and screwed into the housing. We have experimented with heavier dynamotors and have found a similar situ-

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# Chemistry

## DIAGNOSTIC PRINCIPLES IN ORGANIC SYNTHESIS

### II. DERIVATIVES OF BENZENE

REV. BERNARD A. FIEKERS, S. J.

In two places in Conant's textbook<sup>a</sup> there appear exercises and problems in organic syntheses which carry the student through a substantial review of preceding descriptive matter. A set of principles for the exercises in aliphatic chemistry has already appeared in this BULLETIN.<sup>b</sup> A similar objective for the aromatic part is had in this paper.

In the aliphatic part of this general problem it is the construction of carbon skeletons that has to be emphasized. The reactions for functions there are but secondary in nature. In that field "total synthesis" is emphasized. In aromatic synthesis, however, carbon ring skeletons are already provided in coal tar crudes. The problem is reduced to the interplay between the introduction of functional groups, their transformations and the rules of orientation that will place them in the proper positions.

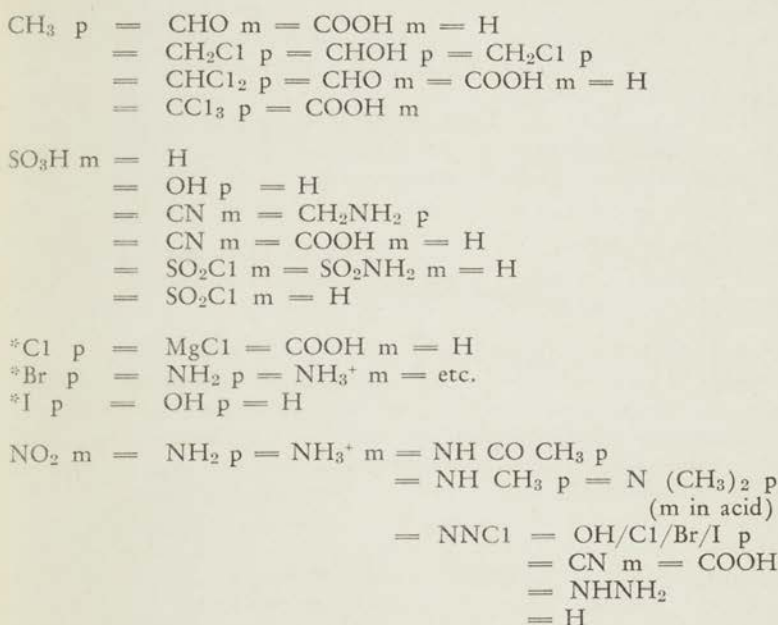
For content this paper will be limited to the derivatives of benzene, excluding naphthalene and other poly-ring systems. The only alkylated benzene to be emphasized here is toluene. The paper is written from the viewpoint of classroom exercises and in the hope of some progressive work in educational laboratories. Hence there arises further limitation to derivatives that contain at most three or four substituents. The paper is based on Conant's text and presents in addition suitable material from the first twenty-eight volumes of *Organic Syntheses*.<sup>c</sup>

Such exercises are generally stated as follows: Given coal tar crudes, such as benzene, toluene, the xylenes, phenol etc., indicate a series of reactions necessary for the synthesis of a required benzene derivative. Similarly the shortest or the synthesis for purest product might be required.

To work backward mentally from final product to initial crude, as Conant suggests, is a very difficult task in practice. To work directly forwards is equally difficult. We have struck upon the method of suggesting commonly available intermediates for the work and will put these at the central point of the scheme, leaving the direction of work otherwise optional. These intermediates include: m-nitraniline, p-nitraniline, sulfanilic acid, p-toluene sulfonic acid, o- m- and p-toluidine.

## PRELIMINARY PRINCIPLE

Group Transformations. This list is not exhaustive, but it has been judged to be within the scope of the problem and to be reasonably adequate.



The transformation to H is indicated because frequently an "erasure" stratergen is required. In it a group is removed and replaced by H. The transformations for "erasure" are listed in the following order of their importance:  $\text{SO}_3\text{H}$ ,  $\text{NH}_2$ ,  $\text{COOH}$ . By using this list of transformations one can construct the sequence of reactions so that the proper directive influence of groups is used to advantage. Notice that the groups to the extreme left of the scheme are those that can be introduced into the ring directly without transformation from other groups. Other groups in the scheme can be used directly too, but they are of lesser importance. Most of them have to be used indirectly, that is by transformation.

**PRINCIPLE I.** *If the desired product contains the CHO or COOH groups, start with toluene or an appropriate xylene (50). Transformation by oxidation is illustrated in references 16, 31, 42, 49 and 58. For halogenation and subsequent hydrolysis see references 4, 15, 40 and 41.*

\*Halogens used interchangeably.

PRINCIPLE II. *If the desired structure contains the CH<sub>3</sub> or OH groups, start from the corresponding coal tar crudes.* This principle should shorten the number of reactions that might be necessary and minimize the difficulty of a Friedel-Crafts reaction in alkylating a ring that is already substituted. For other alkyl benzene derivatives a convenient external source of them should be sought (50, 56), or the synthesis should be so planned that the necessary derivative is made at an early stage. Such derivatives will not be discussed further in this paper, except for toluene, for which special methods will be suggested. If phenolic derivatives cannot be supplied by this method, the list of transformations should provide ample material for making up the deficiency. (21, 25) Examples include caustic fusion (21) and the Gattermann reaction (44).

PRINCIPLE III. *Groups should be introduced directly if possible.* The synthesis of many meta di-substituted derivatives use this principle to advantage (6).

PRINCIPLE IV. *Symmetrically trisubstituted structures should be checked.* The introduction of meta directing groups makes for 1,3,5 and 2,4,6 symmetry. Examples include trinitrobenzene (57, from trinitrobenzoic acid, 58 from trinitrotoluene), direct nitration and analogous sulfonic acids. Trihalogenated aniline (54) and phenol come to mind. Frequently two or more identical substituents on the ring are of little value for further transformation unless specific methods are available for the avoidance of mixed yields. The stepwise reduction of dinitrobenzene with ammonium sulfide is an example of a specific method of wide applicability. Even with this at times the presence of a third substituent cripples the method seriously. Examples of preferred syntheses are available in the literature (2, 22).

PRINCIPLE V. *Two identical substituents para to each other have substantially one product when a third substituent is introduced.* Exercise I. Prepare 1,2,4-trichlorobenzene from p-dichlorobenzene.

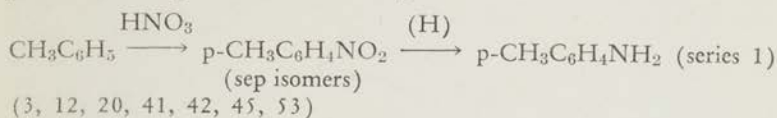
PRINCIPLE VI. *Given a choice of two or more positions to be taken by an incoming substituent, the position farthest removed from those already occupied will be taken.* This occurs in para substitution at times to the exclusion of the ortho isomer, or isomeric physical properties are sufficiently different to allow for a convenient separation of isomers. (8, 13, 33, 34, 47). On the other hand many syntheses are available which do not even allow a choice of position. (3, 6, 7, 9, 10, 23, 24, 26, 27, 30, 35, 39, 43, 46,). The principle can be of value if not abused. Conant, however, generally calls for the separation of ortho and para isomers. Accordingly special methods are required in ortho synthesis.

PRINCIPLE VII. Para Synthesis and Masking. *p-Toluidine is*

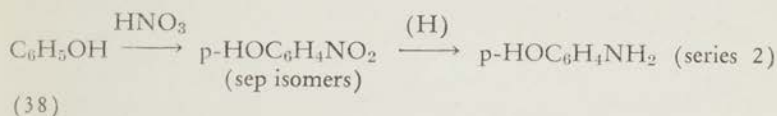


suggested as an intermediate for *p*-toluene derivatives; *p*-amino phenol for phenol derivatives; and *p*-nitraniline for other para derivatives of benzene.

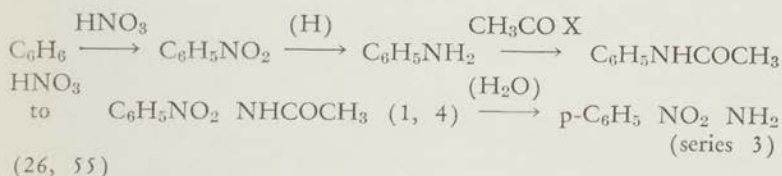
*p*-Toluidine is synthesized over the path:



and *p*-amino phenol as follows:



*p*-nitraniline:



In all three intermediates the versatility of the NH<sub>2</sub> group in transformation is of great value; the fact that it can be "erased" makes it of value in meta synthesis as well. The acetyl mask on the *p*-nitroacetanilide in series (3) may be left on in order to use its directive influence to advantage in further synthesis. Corresponding acetanilides can likewise be made from the end products of series (1) and (2). Another advantage of this mask is the protection of the NH<sub>2</sub> group in oxidative reactions.

Exercise II. Prepare *p*-iodophenol (Conant, p. 477).

Exercise III. Prepare *p*-bromotoluene from toluene (Coll. Vol. I., 136).

Exercise IV. Prepare *p*-iodophenol from phenol (Coll. Vol. II., 355).

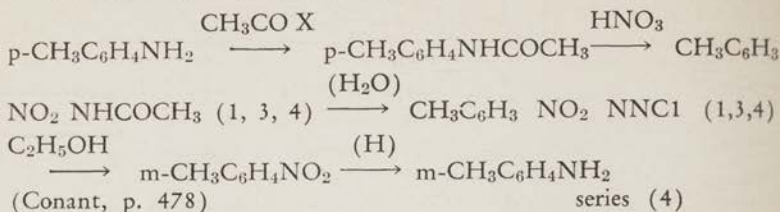
Exercise V. Prepare 1) 2, 6-di-iodo *p*-nitraniline (Coll. Vol. II., 196)

2) 1,2,3-tri-iodo 5-nitrobenzene (Coll. Vol. II., 604)

Di-ortho halogenation of these anilines might be feasible, in analogy with trihalo aniline reactions and suggested by references 23, 24 and 26.

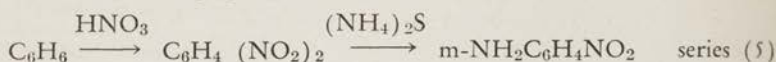
PRINCIPLE VIII. Meta Synthesis. Blocking of the Para Position. *m*- and *p*-Toluidine are the suggested intermediates for the production of *m*-toluene derivatives; and *m*-nitraniline for other derivatives. *m*-Amino phenol can be used to advantage.

m-Toluidine is made from p-toluidine by a continuation of series (1):

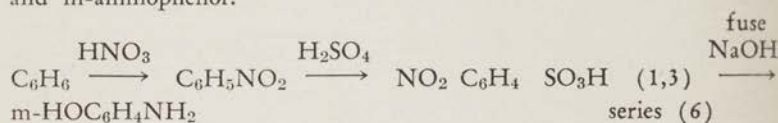


Along the paths of series (1) and (4) other groups can be introduced into the 3 and 4 positions (3, 4, 5, 11, 12, 15, 20)

m-Nitraniline is prepared from benzene in the series:



and m-aminophenol:



Exercise VI. Prepare m-iodophenol from benzene (Conant, 478).

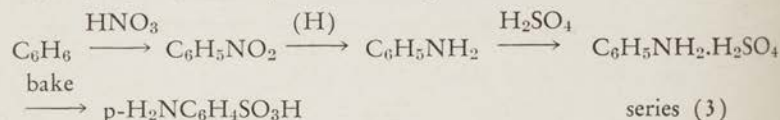
Exercise VII. Prepare m-bromo aniline from benzene.

Exercise VIII. Prepare m-chloronitrobenzene (18).

Exercise IX. Prepare m-nitro phenol (44).

Exercise X. Prepare m-nitrotoluene (45).

PRINCIPLE IX. Ortho Synthesis. Blocking the Para Position *Sulfanilic acid is the intermediate suggested for the production of ortho compounds.* Ortho compounds have to be produced indirectly by plugging (10, 23, 24, 39) the para position with a meta directing substituent that can be removed with ease ( $\text{SO}_3\text{H}$ ,  $\text{NO}_2$ , 10, 11, 23, 24, 37, 39, 45, 54). Its serial synthesis follows:



Exercise XI. Prepare o-nitraniline from benzene (Conant 479. Masking and subsequent removal of the  $\text{NH}_2$  group is necessary.)

Exercise XII. Prepare o-nitrotoluene, o-toluidine, o-tolunitrile and o-toluic acid from toluene (52).

p-Toluene sulfonic acid, p-toluidine and o-toluidine can be used for ortho synthesis. o-Toluidine is generally got from the industrial separation of nitrotoluene isomers. Frequently in ortho synthesis one ortho position and the para position is plugged with a sulfonic acid group in order to leave the other ortho position free for reaction (7). This takes advantage of the predominant tendency

for groups to enter the para position according to Principle VI. After the first addition of  $\text{SO}_3\text{H}$ , whatever ortho substituted compound is present will be much more likely to substitute in the para position on the second addition.

---

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  2. 2-Amino, 4-nitrophenol from 2, 4-dinitrophenol by  $\text{Na}_2\text{S}$  reduction, *ibid.*, 25, 5.
  3. 3-bromo, 4-aminotoluene from p-toluidine by addition, *ibid.*, Coll. I., 111.
  4. p-Bromobenzaldehyde from p-bromotoluene by halogenation & hydrolysis, Coll. II., 89.
  5. 3-Bromo, 4-hydroxytoluene from 3-bromo, 4-aminotoluene 23, 11; from p-toluidine, Coll. I., 111.
  6. m-Bromonitrobenzene from nitrobenzene by addition, Coll. I., 123.
  7. o-Bromophenol from phenol (o, p-disulfonic acid) by addition, Coll. II., 97.
  8. p-Bromophenol from phenol by addition, Coll. I., 128.
  9. 4-Bromoresorcinol from 2, 4-dihydroxybenzoic acid by decarboxylation, Coll. II., 100; from resorcinol by carboxylation, Coll. II., 557.
  10. o-Bromotoluene from o-toluidine, Coll. Vol. I., 135.
  11. m-Bromotoluene from 3-bromo, 4-aminotoluene by "erasure", Coll. I., 133; from p-toluidine, Coll. I., 111.
  12. p-Bromotoluene from p-toluidine (Sandmeyer), Coll. I., 136.
  13. 4-Bromo, o-xylene from o-xylene by halogenation, 28, 22.
  14. m-Chlorobenzaldehyde from m-nitrobenzaldehyde (Sandmeyer) Coll., II., 130.
  15. p-Chlorobenzaldehyde from p-chlorotoluene by chlorination & hydrolysis, Coll. II., 133; from p-toluidine, Coll. I., 170.
  16. o-Chlorobenzoic acid from o-chlorotoluene by oxidation, Coll. II., 135.
  17. o-Chlorobromobenzene from o-chloro aniline (Sandmeyer), 24, 22.
  18. m-Chloronitrobenzene from m-nitraniline (Sandmeyer), Coll. I., 162.

19. *o*-Chlorotoluene from *o*-toluidine (Sandmeyer), Coll. I., 170.
20. *p*-Chlorotoluene from *p*-toluidine (Sandmeyer), Coll. I., 170.
21. *p*-Cresol from *p*-toluene sulfonic acid (caustic fusion), Coll. I., 175.
22. 1, 2-Diamino, 4-nitrobenzene from 2, 4-dinitroaniline by ammonium sulfide reduction, 21, 20; from 2, 4-dinitrobenzene, Coll. II., 221.
23. 2, 6-Dibromoaniline from sulfanilamide, 24, 47.
24. 2, 6-Dichloroaniline from sulfanilamide, 24, 47.
25. 3, 5-Dihydroxybenzoic acid from benzoic (disulfonic) acid by caustic fusion, 21, 27.
26. 2, 6-Diiodo, *p*-nitraniline from *p*-nitraniline by ICl, Coll. II., 196.
27. 3, 5-Diiodo Salicylic acid by ICl, Coll. II., 343.
28. 3, 4-Dimethyl aniline from 4-bromo *o*-xylene by amination, 28, 46; from *o*-xylene, 28, 32.
29. 2, 4-Dinitroaniline from 2, 4-dinitro chlorobenzene by amination, Coll. II., 221.
30. 3, 5 Dinitrobenzoic acid by nitration, 22, 48.
31. 2, 5 Dinitrobenzoic acid from 2-amino, 5-nitrotoluene by oxidation, 22, 44.
32. *p*-Hydroxybenzoic acid by rearrangement salicylic, Coll. II., 341.
33. *p*-Iodoaniline from aniline by halogenation, Coll. II., 347.
34. 5-Iodoanthranilic acid by ICl, Coll. II., 349.
35. Iodobenzene from benzene by halogenation, Coll. I., 323.
36. Iodobenzene from aniline (Gattermann), Coll. II., 351.
37. *m*-Iodobenzoic acid from 5-iodoanthranilic acid by "erasure", Coll. II., 353; from anthranilic acid, Coll. II., 349.
38. *p*-Iodophenol from *p*-aminophenol (Gattermann), Coll. II., 355.
39. *o*-Nitraniline from *o*-nitraniline *p*-sulfonic (*o*-nitraniline equals *p*-sulfonic) acid, Coll. I., 388.
40. *o*-Nitrobenzaldehyde from *o*-nitrotoluene by oxidation, 24, 75.
41. *p*-Nitrobenzaldehyde from *p*-nitrotoluene by oxidation, Coll. II., 441.
42. *p*-Nitrobenzoic acid from *p*-nitrotoluene by oxidation, Coll. I., 392.
43. *m*-Nitrodimethylaniline by nitration, 27, 62.
44. *m*-Nitrophenol from *m*-nitraniline (Gattermann), Coll. I., 404.
45. *m*-Nitrotoluene from *m*-nitro *p*-toluene, Coll. I., 415 "erasure".
46. Resorecylic acid from resorcinol by carboxylation, Coll. II., 557.
47. *p*-Tolualdehyde from toluene (Friedel), Coll. II., 583.
48. *o*-Toluic acid from *o*-tolunitrile by hydrolysis, Coll. II., 588; from *o*-toluidine, Coll. I., 514.
49. *o*-Toluic acid from *o*-xylene by oxidation, 27, 84.
50. *p*-Toluic acid from *p*-cymene by oxidation, 27, 86.
51. *o*-Toluidine sulfonic acid from *o*-toluidine, 27, 88.
52. *o*-Tolunitrile from *o*-toluidine (Sandmeyer), Coll. I., 514.

53. p-Tolunitrile from p-toluidine (Sandmeyer), Coll. I., 514.
54. sym-Tribromobenzene from aniline by halogenation and "erasure", Coll. II., 592.
55. 1, 2, 3-Triiodo 5-nitrobenzene from 2, 6-diiodo p-nitraniline (Gattermann), Coll. II., 604; from p-nitraniline, Coll. II., 196.
56. 2, 4, 6-Trimethylbenzaldehyde from mesitoyl chloride by reduction, 21, 110.
57. sym-Trinitrobenzene from sym-trinitrobenzoic acid by decarboxylation, Coll. I., 541; from 58.
58. sym-Trinitrobenzoic acid from trinitrotoluene by oxidation, Coll. I., 543.

NOTE: Additional entries under any item indicate sources of previous structures mentioned in that item.

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### EXPONENTS APPEARING IN CHEMICAL RATE EXPRESSIONS

REV. BERNARD A. FIEKERS, S.J.

Given the forward reaction in the following equation:



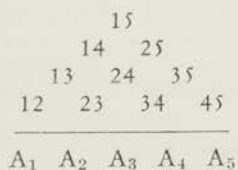
we wish to know why the concentration of the species A is squared in the rate expression:

$$\text{Rate}_{\text{forward}} = k(A)^2 \quad (2)$$

The rate of this reaction at equilibrium is proportional to the concentration (A). This is in turn proportional to  $N_a$ , the number of particles of species A, present in a given volume. Hence, it is valid to consider the problem on a number basis, and write:

$$\text{Rate}_{\text{forward}} = K N_a^2 \quad (3)$$

Suppose that only *five* particles of the species A are involved in reaction. Tag them and space them at the base of the following triangle:



Construct the rest of the triangle as follows. Check off the opportunity for particle no. 1 to react with no. 2 by writing 12 in the diagram; 2 with 3, by writing 23; 2 with 5, by writing 25 and so on.

Notice that the numbers 21 and 52, for example, do not appear, because they would duplicate 12 and 25 respectively. All possibilities are then exhausted, and none are duplicated.

The sum of the opportunities for reaction, shown in the triangle, is given by:

$$1 + 2 + 3 + 4 = 10 \quad (4)$$

It is also given in general by:

$$\text{Sum} = n(n + 1)/2 = (n^2 + n)/2 \quad (5)$$

where  $n$  is the highest number added in equation (4), or, since the triangle is equilateral, it is the number of units along an edge.

In the above example, this number is four. The summation formula should, however, be translated into the number of particles of species A, which is  $n + 1$ , or five. Let then  $N = n + 1$ , and equation (5) becomes:

$$\text{Sum}_{\text{opportunities}} = (N_a^2 - N_a)/2 \quad (6)$$

$$\text{is almost equal to } N_a^2/2 \quad (7)$$

where  $N_a$  is equal to the number of particles of species A involved in the reaction.

If this last approximation can be allowed, then equations (2) and (3) are valid to the same extent. With only five particles of species A, the sum of opportunities is 10 by equation (6); and 12.5 by equation (7); the error being 25%. With  $6.0 \times 10^{23}$  particles, corresponding to a mole of the species, the error is vanishingly small: only  $6.0 \times 10^{-21}$  per cent.

It can be shown that when three moles of species A are involved in a fundamental chemical equation, similar to equation (1), then a tetrahedron can be constructed in a similar way. Its summation in terms of the number  $N$  along any edge is given by:

$$\text{Sum}_{\text{opp.}} = \frac{N(N - 1)(N - 2)}{1 \times 2 \times 3} \quad (8)$$

The chemist is seldom interested in generalizations beyond three particles. Second order rate expressions that involve two different species in a one to one ratio present no particular difficulty to the instructor.

The fundamental principles of these considerations have been known for a long time and are encountered in one form or other in texts and in the educational literature of chemistry. The root of the problem has been treated here by concentrating on the rate expression. It comes up at every level of college chemistry. Partition coefficients, solubility products and ionic or non-ionic chemical equilibrium force us to review the rate process. This treatment includes then

some novel aspects and is offered in order to help, the instructor at least, to dispel some of the obscurity that has befogged the problem. The mathematical instructor too may find some interest in this aspect of the chemistry instructor's work. Indeed geometrical figures can be of general pedagogical help in more instances than one.

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(To be continued)

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## RELATIVE MERITS OF VARIOUS COLORIMETERS

(a notice)

Attention is called to an abstract of an article by C. Engel from the *Chemische Weekblad*, 44, 309-312 (1948), which appears in *Chemical Abstracts*, 42, 7110-7111 (1948). The Klett, Kipp, Hilger, Klett-Summerson, Coleman Universal II., Lumetron 402-E, Evelyn Electric and Kipp (of Delft, Holland) Models were studied and compared; specifications were proposed; and the announcement was made that Kipp has prepared a model to meet these specifications.

B. A. F., S.J.



# Mathematics

## THE LEAST COMMON MULTIPLE

### AN APPLICATION OF ABSTRACT ALGEBRA

C. FREDERICK KOEHLER, S.J.

Very often concepts which are introduced into even elementary algebra as new and independent of those which preceded, could be shown to be really conclusions, and intrinsically related to the matter already developed. This process would enable students to perceive mathematics as a logical science, rather than a collection of unconnected postulates which must be committed to memory. For example, after the ideas of multiplication, factoring, and the greatest common divisor have been developed, texts usually define the notion of least common multiple, postulate its existence, and explain its utility. Yet by treating algebra abstractly we can prove, rather than postulate, the existence of a least common multiple for polynomials and integers, and give it an intrinsic definition based on what has preceded, rather than a description as something entirely new.

Thus:

Let  $a$  and  $c$  be two positive integers or polynomials; let  $(a, c)$  be a symbol to indicate the greatest common divisor of  $a$  and  $c$ .

*Theorem: The quotient, formed from the product of the integers  $a$  and  $c$  divided by the greatest common divisor of  $a$  and  $c$ , is itself a multiple of  $a$  and  $c$ , and divides every other multiple of  $a$  and  $c$ .*

*Proof:* Any integer  $a$  and  $c$  can be written as a product of  $(a, c)$  and some other integer.

$$\text{Hence} \quad a = a' \cdot (a, c) \quad (1)$$

$$\text{and} \quad c = c' \cdot (a, c) \quad (2)$$

Multiplying equations (1) and (2) we obtain:

$$a \cdot c = a' \cdot c' \cdot (a, c) \cdot (a, c) \quad (3)$$

Now, considering  $a'$  and  $c'$ , we know that  $(a', c') = 1$ . For if there were a greatest common divisor  $y$  of  $a'$  and  $c'$  which did not equal 1, then  $y$  would be common to the right side of equations (1) and (2), and so  $y \cdot (a, c)$  would be the greatest common divisor of  $a$  and  $c$ . Write equation (3) as:

$$\frac{a \cdot c}{(a, c)} = a' \cdot c' \cdot (a, c) \quad (4)$$

The right side of equation (4) is a *multiple* of both  $a$  and  $c$ . For if we divide both sides by  $a$  we see that on the left side  $a$  will cancel in numerator and denominator. Of course,  $(a, c)$  divides  $c$ . The same argument holds for  $c$ . It remains to prove that the right side of equation (4) *divides every other multiple* common to both  $a$  and  $c$ .

Let  $x$  be any common multiple of  $a$  and  $c$ . By equations (1) and (2):

$$x = a \cdot w_1 = a' \cdot (a, c) \cdot w_1 \quad (5)$$

$$x = c \cdot w_2 = c' \cdot (a, c) \cdot w_2 \quad (6)$$

Hence  $a' \cdot w_1 = c' \cdot w_2$  or  $\frac{a' \cdot w_1}{c'} = w_2$

Now  $c'$  is not a divisor of  $a'$  for  $(a', c') = 1$ , and since  $c'$  divides  $a' \cdot w_1$ , then  $c'$  is a divisor of  $w_1$ .

$$\frac{w_1}{c'} = z \text{ or } w_1 = c' \cdot z$$

Substituting in equation (5)

$$x = a' \cdot (a, c) \cdot c' \cdot z.$$

This shows that  $a' \cdot (a, c) \cdot c'$  is not only a common multiple of  $a$  and  $c$ , but it divides every other common multiple  $x$  of  $a$  and  $c$ , since  $x / (a' \cdot (a, c) \cdot c') = z$ . Hence, it is a *least common multiple*. Therefore, by equation four

$$\frac{a \cdot c}{(a, c)} = \text{least common multiple of } a \text{ and } c.$$

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(Continued from page 85)

ation in all cases. The beauty of the conversion is its compactness and range of power for the use indicated.

Radio and other electronic tubes are a familiar sight in collections of surplus materials. One difficulty encountered in trying to put them to use is the fact that they are frequently characterized by a "service number" instead of the familiar "commercial number". This difficulty may be overcome in part by consulting certain tube testers, that also occur in war surplus, and list the methods of testing according to both "service" and "commercial numbers". Espey Manufacturing Company's Model 104 Combination tester has a visible index inside its case for just this purpose. Data are available for finding many of the commercial numbers that correspond to the service

(Continued on page 101)

## Obituary Notices

REV. JOHN A. S. BROSNAN, S.J. 1860-1948

The ASSOCIATION is grieved at the death of its oldest member and friend of every member. The BULLETIN hopes to be able to publish the obituary of Father John Brosnan in the May issue + Dec. 9, 1948. R. I. P.

REV. GEORGE J. PICKEL, S.J. 1867-1948

The passing of a Jesuit chemist in Cleveland may be news to many who knew Father George J. Pickel, S.J. through his survey of our own departments before he built the new department at John Carroll University in Cleveland; through his papers at the National Meeting of the ASSOCIATION in Chicago in 1940; and through meeting him at conventions of the American Chemical Society from time to time. Father Pickel was born on July 6, 1867 at St. Louis, Mo. In 1885 he graduated from Sacred Heart College in Prairie du Chien, Wis., with the A.B. degree. In 1888 he entered the Society at Blijenbek, the Netherlands. From 1892 to 1894 he taught Latin in St. Ignatius College, now John Carroll University. From 1894 to 1901 he did his philosophy and theology at Jgnatiuskolleg, Valkenburg, the Netherlands. He was ordained in 1900. From 1901 to 1903 he pursued special studies in physics and chemistry at the University of Goettingen in Germany. Since then he held various administrative and teaching positions as follows: 1904 to 1907, Professor of Chemistry, St. Ignatius College in Cleveland; 1907-1910, President of the College; 1910-1925, Professor of Chemistry at Campion College; 1925 to 1927 Professor of Chemistry, Spring Hill College, Spring Hill, Ala.; 1927 to 1948, Professor of Chemistry and Head of Department at John Carroll University in Cleveland, Ohio. During the summer sessions of 1919 to 1925 he taught chemistry at Creighton University, Omaha, Neb. From 1937-1938 he was acting Rector of John Carroll University.

Some of the outstanding facts and connections in Father Pickel's life that space permits us to mention may be of interest to many. During his sojourn in Europe he was a classmate of the Jesuit physicist, Father Wulf. Indeed, they were contemporaries, and classmates at Valkenburg and Goettingen. This serves to emphasize the early scientific training of many of our men. At that time a number of Jesuits from the area of the American Assistency did special scientific studies in Europe and particularly in Germany. Many of them obtained higher

degrees, or passed the "Staatsexamen", at a time when science in the American Universities was just growing up. Father George Coyle's great work in dye chemistry stems from this time. Similarly Father Pickel's interest in the chemistry of resins and plastics might find its root right here. John Carroll University was probably the first in the country to institute an undergraduate course in Plastics and Resins. Father Pickel wrote his own laboratory manuals for this course and for many other chemistry courses. He emphasized the synthetic over the analytic. His office became a veritable museum of plastic samples from his own laboratory and from industries throughout the land.

All the while Father Pickel was a great teacher of chemistry. He aged gracefully and showed a kindly interest in all the doings of his proteges in the science. In the loss of Father Pickel a great living source of inspiration to our younger men has passed. The memory of him still inspires. + May 21, 1948. R. I. P.

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REV. ROBERT E. BROWN, S.J. 1877-1947

*Letters and Notices* for September 1948 carries some items of scientific interest in the obituary of Father Robert E. Brown, 1877-1947. He spent his regency from 1902-1906 at the Observatory in Manila with the Spanish fathers. On arrival in the Philippines he was first occupied with a translation of a work written on cyclones by Father Algue, the Director of the Observatory. In addition to his normal work in the observatory he took over from Father W. Stanton—afterwards a famous preacher—certain entomological observations for the Department of Agriculture. He discovered a new genus and eleven species of Hymenoptera. He also shared in the work of U. S. cable communications through Guam and Yap as well as in the establishment of a meteorological station on Guam. On his return to England to finish regency, he published in the *Tablet* an account of the polemic between our Fathers and the meteorologist in Hong Kong on the publication of meteorological warnings that were made outside of the Philippines. He seems to have been responsible for the adoption of the white soutan in the islands, and later as Missionary Superior in Zambesi he got the missionaries to abolish the custom of wearing beards by the ingenious device of giving them razors at Christmas time. He founded the house, for students of "ours" at London University, on Endsleigh Street in London and later moved it to Fitzjohn Ave. R. I. P.

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REV. LOTHAR KOENIG, S.J. 1906-1946

Father Koenig, of the Upper German Province, was a Jesuit Scientist who received his doctorate *magna cum laude* from the University of Munich during the late thirties. But, as far as can be ascer-

tained, he never taught the sciences for any great length of time. Even his appointment as Professor of Cosmology in Pullach became, due to the outbreak of war, an empty assignment.

The talent that he had developed from the days of Technical High School in his native Stuttgart, at the University of Munich, as District Leader for Wurttemberg in the Catholic Youth Movement and throughout the course in the Society was turned in another direction. With unbelievable energy he travelled time and again during the war to every Bishop in Germany in the interest of religious houses and of the Church. The State Secret Police hunted him down, so that he had to hide out in the country for a period of nine months. Another Jesuit, Father Spitzen, was thrown into Dachau as a hostage for him. At the time of the arrival of Allied troops in 1945 he came out of hiding. He had contracted disease and could not get the medicines necessary to prolong his life. He realized this clearly and devoted the last year of his life up to the very last hour to the reconstruction of his Province. He rests in the cemetery at Pullach, which he himself had saved from the ravages of war. + May 5, 1946. R. I. P.

*From private communication, obituary notice Mitteilungen, 1946, p. 16.* B. A. F.

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REV. ALBERT MARING, S.J. 1883-1943

Concentration Camp, Dachau, includes a quondam Jesuit Physicist in its toll. Father Maring had studied at Copenhagen under Knudsen and Bohr. He held the M.S. degree from that university. In 1917 he contributed an article on a mercury high vacuum pump to the *Zeitschrift fuer den physikalischen und chemischen Unterricht*, 30, 241-243 (1917). Since then his assignments in the Society did not utilize his scientific background so directly. He went to Dachau on charges of treasonable tendencies and specifically on account of intimate transactions with Father Fr. Muckermann, who was being sought by authorities of that time. A protracted obituary of Fr. Maring is to be found in *Mitteilungen aus den deutschen Provinzen der G.J.*, no. 110, pp. 53-59 (1946). + April 8, 1943. R. I. P.

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numbers. If the interest in this data warrants it, lists can be published in the BULLETIN from time to time.

A "Shadograph", evidently used in war production for checking the weights of parts on assembly lines, came to one of our colleges through war surplus. With its weights can be read to one tenth of a gram and estimated to hundredths. It has been set aside for the calibration of large volumetric flasks in the courses of quantitative analysis and physical chemistry. It was manufactured by the Shadograph Exact Weight Scale Co., Columbus, Ohio.

(Continued on page 108)

## News Items

*"Magnopere juverit crebro alios de aliis certiores fieri, ac audire quae ex variis locis ad aedificationem et eorum quae geruntur cognitionem afferuntur."*—Const. VIII., I.

### FORDHAM UNIVERSITY CHEMISTRY DEPARTMENT

On Monday October 4, the Graduate Seminar was addressed by Dr. Eric Pietsch on the subject "Basic Aspects of Corrosion Behavior." Dr. Pietsch is the director of the Gmelin Institute for Inorganic Chemistry at Clausthal, Germany. He is also editor of the Gmelin Handbook which is the most comprehensive international catalog of Inorganic Compounds and Processes. On Wednesday, November 10, the speaker at the second public seminar was Dr. Edward J. Hehr of Cornell University Medical College who spoke on "Enzymatic Synthesis of Polysaccharides."

Dr. Eric Hutchinson has been appointed Assistant Professor of Physical Chemistry at Fordham. He comes from Stanford University where he was the Bristol Meyers Post-doctorate Fellow and Research Associate with J. W. McBain F.R.S. for the past two years. His doctorate was obtained at Cambridge under E. K. Ridial F.R.S. While a post-doctorate fellow at Bristol Meyers, Dr. Hutchinson published "Films at Oil-Water Interfaces" I and II: *J. Colloid Science* 3, 219-234; 235-250 (1948).

The enrollment of chemistry graduate students this year is one hundred and fifteen.

On November 16 over WNYC at 10 A.M., Father Gisel was interviewed by Mr. George Boehm on the "Headline in Chemistry" program which is supervised by the American Chemical Society. During this interview Father Gisel told of his experience in Japanese occupied Philippines.

Registration for the Industrial Chemistry Course which was started last year has increased 3 fold. This is a lecture course. The laboratory course which supplements Industrial Chemistry is called Technical Analysis during which it is designed to teach the application of the principles of commercial testing and the interpretation of results rather than to develop manipulation skill.

Dr. William F. O'Connor was recently elected to two year Alternate Councilor of the American Chemical Society.

Editor's Note. *The New York Province Newsletter* for November 1948 mentions tentative plans for the extension of the chemistry building at Fordham among other plans for expansion.

F. F. Nord of Fordham University will receive the third Carl Neuberg Medal at a meeting of the Society of European Chemists and Pharmacists in America in New York City on Jan. 27. He was a former worker under Neuberg at the Kaiser Wilhelm Institut in Germany. *Chem. & Eng. News*, 27, 167 (1949)

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## COLLEGE OF THE HOLY CROSS

### ASTRONOMICAL OBSERVATORY

Since 1947 an astronomical observatory has graced the hilly campus of the "Cross". Use was made of one of the old brick service buildings at the northeast corner of the upper campus behind the students' chapel. The installation includes office, dark room, heating plant, storage space and observatory proper. Equipment includes communication, photographic and calculating items, and a five-inch telescope. Fr. James K. Connolly, S. J., astronomer and founder, is in charge. We hope to offer a detailed description of the plant in some issue of the BULLETIN in the near future.

### CAMPUS RADIO STATION

One of the highlights of the present scholastic year at Holy Cross is the opening of the campus radio station. Studio construction was completed in November and station WCHC is now on the air with its daily program.

This station is operated entirely by the students and follows the general procedures of the Intercollegiate Broadcasting System. Transmission is of the carrier-current type with signals confined to the campus. Broadcasts of basketball games, originating in Boston and Providence, have been conducted over this station. Local stations have channelled some of our programs for public broadcast as well. Radio experts agree that our campus radio setup has its place with the best of all other campus members of the Intercollegiate Broadcasting System in this area.

The newly-formed Radio Workshop, members of which operate the station, have had the generous co-operation of the Holy Cross Amateur Radio Club in all technical fields. Members of that group have constructed in part, assembled and installed the transmitter. This has been tested and found to be most efficient. The initial broadcasts prove that Holy Cross is ready to make her bid for nationwide prominence among collegiate stations.

Faculty members, college departments and extra-curricular groups have all expressed their willingness to contribute programs and the student body in general has manifested an enthusiasm for the project which promises much success for Station WCHC. The rapid progress of the Radio Workshop is due to the able direction of Fr. John H. Kelly, S. J. and the hearty co-operation and en-

couragement of Fr. John A. O'Brien, S. J., President of the College, and Fr. William J. Healy, S. J., former President.  
*Holy Cross Alumnus*, 23 (2), 1 (1948)

#### DEPARTMENT OF CHEMISTRY

Staff membership consists of six men: three hold the doctorate and three the master degree. A seventh is on leave for his doctorate. As best we can ascertain eighteen alumni from the department have received the doctorate in chemistry. Doctorates were conferred on these at the following universities and technical schools: Boston University, Clark, Columbia, Fordham, Georgetown, Iowa, Johns Hopkins, Mass. Inst. Tech., Purdue, St. Louis and Yale. Sixteen alumni are currently studying for their doctorates at the following universities: Boston University, Clark, Columbia, Cornell, Notre Dame, Ohio State, Pittsburgh, Rochester, Syracuse and Toronto.

Recent improvements in the department include the following: fluorescent lighting in two laboratories, the acquisition of an O. G. precision refractometer, a Roller Smith ring surface tension apparatus, an additional pH meter, an ultrasonator, two E. Greiner manostats, an Aberhalden drying gun, a vacuum oven, six analytical balances, steam fans, Fenwal switches immersion heaters and other controls for thermobaths, vacuum pumps, small drill presses, a Casco grinding kit and the like. Many of these items were sponsored by the Sugar Research Foundation; a few originated in war surplus.

Dr. O. L. Baril held the seminar at Clark University on January 5, 1949 and spoke on the Wohl-Ziegler reaction for substituting bromine into unsaturated organic compounds. Research by our M.S. candidates includes the following topics: solubilizing agents, optimum conditions for maltose determination, gentisic acid study and the effect of ultrasonics on oversaturated sirups. We have six graduate assistants and are accepting a seventh for the February term. There will be openings for six in September. Applications will be due late in March.

One hundred small H.P. universal motors were recently acquired by the department from a surplus source. They are being installed in our organic laboratory, with suitable control devices, and in a permanent way, so that each workdesk in organic will be provided with a stirrer. Thus maintenance and bookkeeping on these is minimized. In this way we hope to achieve greater flexibility in choosing the undergraduate organic chemistry experiments that may be performed.

The department has often been called upon with requests to supply extra backnumbers of journals for our new libraries in this country and in the missions. At present we are trying to get a run of *Chemical Abstracts* from 1935-1945 inclusive for the mission in Baghdad. Gifts for this worthy purpose will be greatly appreciated.



WESTON COLLEGE  
SEISMOLOGICAL OBSERVATORY

The new Observatory Building should be ready for occupancy sometime in April, if things go well. At the time of writing these items in January, all of the material for the interior of the building is on hand, it is merely a case of obtaining the labor and, of course, the money to pay for it. There is approximately 7,000 sq. ft. of floor space in the building, but we are beginning to wish it were more.

Field seismology took most of our time during the past summer. Besides the regular highway research studies we have been conducting for the Commonwealth of Massachusetts over the past few years, we were also engaged in surveying for water supplies for various municipalities in Massachusetts and Connecticut. A seismic survey for the Pennsylvania Power and Light Company in Hawley, Pa., was an especially interesting one. This study had to do with a landslide area that threatened to destroy an aqueduct that supplied power for a hydro-electric plant operated by that Company. It has been interesting to note the increased use of seismic studies in local geological and engineering problems. Prior to 1940, the seismic method was unknown in this region for the use we have put it to, but within the last few years, practically every Engineering firm has at least heard of it, and most of the major firms have requested our assistance at some time or other. At present we could keep at least three crews operating during the summer months on straight commercial problems.

Editor's Note. The Seismological Observatory at Weston is a Department of Boston College. A detailed report of building progress, new personnel and equipment, along with activity in the field during the summer of 1948 appears in the *New England Province News*, 12 (2), 1 & 2 (1948).

Father Linehan has been appointed to the committee to prepare for the 1952 meeting of the American Geological Society along with representatives from other universities in the Greater Boston area. *N.E. Province News*, 12 (3), 2 (1948).

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FAIRFIELD UNIVERSITY

Xavier Hall is the second new classroom building at Fairfield. The science units for chemistry, physics and biology with their excellent laboratory equipment are of special interest to all visitors. Each unit provides two laboratories, a technique room, a large supply room and an office. A dark room for photographic work is also featured. A meeting of the Bridgeport science teachers was conducted in Xavier Hall early in December. *N.E. Province News*, 12 (3), 2 (1948).

## V A R I A

CAMPION. Radio contact with Belize was made on the morning of October 6 and 7, 1948. For the first time, as far as is known a bishop delivered his first message to his diocese by way of amateur radio. *News Letter, Missouri Province.*

*Editor's note: It would be well if our campus amateurs, Jesuit and laymen, could get to know each other in this way. Possibly some radio enthusiast might be interested in sending a questionnaire out to our educational institutions, inquiring as to call letters, wave lengths, operating times and the like. We would be glad to publish a summary of such data in the BULLETIN; indeed to cooperate in the project by stenciling the addresses on the envelopes of the questionnaire from our mailing lists.*

CANISIUS COLLEGE. The *Kircher Review* is the name of a new student monthly in biology published by the tribeta alpha theta chapter at Canisius. At present it appears in mimeographed form and is being sent to Jesuit Colleges in the East. Catholic Digest for November published an article by James R. Cleary, senior at Canisius, entitled *Father Baker's Gas Wells*. *N.Y. Prov. Newsletter*, Dec. 1948. Fr. J. J. Pallace of Canisius is chairman of the Niagara Chapter of the American Institute of Chemists. An experimental radio and transmitting station is being set up by Mr. Devereux on the top floor of the science building. *Ibid.*, Nov. 1948.

CREIGHTON UNIVERSITY. Dr. D. J. Hengerty, acting director of the department of biochemistry in the University of Ottawa last year, and native of Dublin, Erie, has joined the staff of the Medical School as instructor of biochemistry. Four of the five prizes offered at the meeting of the Midwest Clinical Society were won by doctors from the School of Medicine for their exhibits. The School of Medicine has received a grant of \$25,000 for improvement in the instruction in neoplastic diseases from the U. S. Public Health Department, and one of \$2,500 for research in cancer from the Nebraska Cancer Society. The School of Dentistry has received from the U. S. Government a \$4,050 cancer teaching grant.

K O C U, the campus carrier-current radio station, has eighty-six students on its roster of active participants. Students organize and produce nine hours of programs each week under Daniel Petrie, faculty director of radio. KOCU is the first campus wired station to carry the Sacred Heart program. *Missouri Province Newsletter*, December 1948.

UNIVERSITY OF DETROIT. A program is under way to modernize and improve the University wind tunnel so that it may remain the best in the country. The main features are to increase the air speed in a test section from one hundred to two hundred miles per

hour; and to design and install a six-component balance system instead of the present three-component one.

Dean Freund was appointed to the presidency of the American Society for Engineering Education in June 1948. *Chicago Province News Chronicle*, October 1948.

A complete new metallographic unit has been provided for the Chemical Engineering department through a grant of the Ford Foundation. *Ibid.*, 13 (4), 44 (Jan. 1949).

GEORGETOWN UNIVERSITY. The American Medical Association has approved the Medical Centre as a training place for medical technicians and for Residences in Psychiatry and Diagnostics. In the Medical School all members of the Junior class passed the first part of the National Boards. The present freshmen number one hundred and twenty from fifty-two institutions and twenty-five states. *N.Y. Province Newsletter*, November 1948.

*Chemical and Engineering News* carried a notice on a new cancer laboratory at the Georgetown Medical School. (p. 3704, 1948).

JOHN CARROLL UNIVERSITY. The seismograph has a new automatic alarm for indicating when the instrument is active. This gives the advantage of prompt notification to the press.

Professors John Gallon and William J. Scharf have been added to the faculty in biology and mathematics respectively. Mr. Gilchrist is finishing excellent work on nerve research at St. Louis University.

*Cbi. Prov. Chronicle*, Oct. 1948.

LOYOLA UNIVERSITY, CHICAGO. Loyola reports a considerable strengthening of trained scholars in many departments with mention of the department of biology and the Medical School. *Chicago Province Chronicle* for October 1948. Dr. Hugh J. MacDonald has been added to the staff of the Medical School according to *Chemical and Engineering News*, p. 3678, 1948.

LOYOLA COLLEGE, BALTIMORE. Fr. Joseph S. Didusch, charter member of this ASSOCIATION, celebrated his golden jubilee as a Jesuit on August 15, 1948. Congratulations, Father. Father E. S. Hauber is vice-chairman of the Baltimore Chapter of the American Institute of Chemists.

MARQUETTE UNIVERSITY. Dr. Oswald Dresen has been appointed Dean of the Medical School. A grant of \$5,000 has been awarded to the school of dentistry for cancer control and research by the National Cancer Institute. *Missouri Province Newsletter*.

REGIS COLLEGE, DENVER. The mathematics club plans for outside speakers at its meetings each month as well as trips to industrial and scientific centers where the work is based on mathematics.

Father Froebes has perfected a set of experiments on light to be used with equipment that he and Fr. Hecken constructed themselves at a considerable saving.  
*Miss. Prov. Newsletter*, December 1948.

ST. LOUIS UNIVERSITY. Father Alphonse Schwitalla received a singular award from the American Medical Association at a ceremony in Kiel Auditorium on December 22, 1948. He was the first layman to be given a gold medal and citation for "his outstanding effort for the public welfare on a national level and for his service to American Medicine." His continued ill health has forced him to relinquish his duties as Dean of the Medical School. Father Foote is the new regent and a medical man will be appointed to the post of Dean. *Miss. Prov. Newsletter*, 16 (13), January 1949. Dr. Morris Fishbein, Editor of the *Journal of the American Medical Association* recently honored thirty-seven members of the School of Medicine who have been on the staff twenty-five years. *Miss. Prov. Newsletter*, Dec. 1948.

ST. PETER'S COLLEGE. Student affiliates of the American Chemical Society received their charter as an Affiliate Chapter of the American Chemical Society on November 16, 1948. Two hundred students attended, along with members of other chapters in the state. *N.Y. Prov. Newsletter*. December 1948.

UNIVERSITY OF SAN FRANCISCO. This Fall the University instituted a course leading to the B.S. in Nursing.  
*California Province News*, p. 3, 1948.

WESTON COLLEGE. Fr. M. J. Ahern, first charter member of this ASSOCIATION, took a round trip to Europe last August as a member of the Pilgrimage conducted by Archbishop Cushing. Father Ahern recently treated the community at Weston with a showing of pictures which he took at Lourdes, Rome and Fatima. *New England Province News*, 12 (3), 1 (1948).

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(Continued from page 101)

Advertisements of war surplus items at very reasonable prices are sometimes intriguing. Oxygen gauges were supplied at \$2.00 each by J. Jacob Shannon Co., 214 N. 22nd St., Philadelphia, Pa. By adding a reducing fitting and a needle valve, they worked out admirably in glass blowing. They are designated as USN double gauges pressure reduction regulation valves. We know that they were still available at the end of the summer.

Similarly, the Opad Green Rectifier Co., 71 Warren St., New York, supplied us with selenium rectifiers at reasonable cost. They have worked out very well in electrochemical experiments.