The Prizes of Chemistry

BY ROBERT KENNEDY DUNCAN

Professor and Director of Industrial Research at the Universities of Pittsburgh and Kansas and Visiting Lecturer at Clark University

THERE is nothing in the action of the present-day forces of Innovation that bears any of the symptoms of past history. For the first time in any known era these aspirational forces have gained control, not through the explosive violence of revolution, but through the processes of evolution. As a result we find ourselves saved from revolution, living in an age intensely dynamic, ignorant of where we are going, but on the way.

As is the case, however, with all evolutionary processes, the new and the old exist in curious and incongruous juxtaposition. This state of affairs is particularly impressive as it refers to the evolution of industrial processes and methods—an evolution which, while it is not proceeding in the open, as with governmental and social conditions, is nevertheless of immense significance to the immediate future.

For example, there came into my office yesterday two letters—one from an industrialist, saying, "One great trouble in business is that men are overtrained in the art of money-making through fraud, manipulation, and in practically stealing it by indirection;" and the other from an inventor *re* the inventor, saying that "the possession of inspirational power is the cause of his financial downfall." These two men, one the user of invention and the other the inventor, alike express a large agreement in the idea that one generally robs the other—that it is done by "indirection" is not particularly consoling. That they express a fact of past conditions is undeniable to any one who has ever tried to dispose of a new industrial process, but that they express a fact of general contemporary practice would be scandalously untrue. One of the most remarkable features of this swift industrial transformation that is proceeding is the continual replacement of the common type of commercial pirate, who in the past had directional power over the industries, by men technically trained in the knowledge of the schools and possessed of the determination that their specific type of industry shall win supremacy on its merits and not through the devious paths of business "indirection." To such men the inventor, the innovator, the man with a new idea, is welcome to a degree that is precisely graduated to what, on the basis of shrewd, careful scientific scrutiny, his idea is probably worth.

To-day, in fact, large fortunes are being accumulated by men of creative genius through the co-operation of corporations anxious, and more than anxious, to conduct their operations through the principles of progressive scientific practice. In order to illustrate the opportunities that are ready to hand for young men of scientific training and creative power, and as well to illustrate the anxiety of these large corporations to eliminate waste and to utilize new ideas, it may be interesting to the reader to place before him a few of the announceable inquiries that in the last five weeks have come before the writer merely in his positional capacity.

To begin: Away up in the silver-mining region of northern Ontario there exist vast deposits, tons upon tons—small hills, in fact—of waste silver-extracted residues from the mines. These residues are rich in *cobalt*. Cobalt is a silver-white metal with a faint suggestion of pink; it is tenacious, it can be readily polished, and it exhibits a high luster. It may be considered as a sister to nickel and a cousin to iron; like iron, for example, it is magnetic. *In the metallic state cobalt has found no application whatever in the arts.* Now, it should be remembered that it is not iron and that it is not nickel, but that as

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

an elemental substance it possesses properties that differentiate it from every other substance on earth. Having unique properties, it ought to possess unique utilities, and common experience tells us that these unique utilities have only to be sought to be found. As a mere hint of its possibilities, the writer was shown the other day a knife the blade of which consisted not of iron, but of pure cobalt with a trace of chromium.

Of course the future of this metal lies not in imitating iron or steel, but in transcending these for special purposes and in the utilization of its extraordinary wealth of compounds. Altogether, wealth, reputation, and service await the trained *chemiker* who has the intelligence and persistence to dig them out of these refuse-deposits of northern Ontario.

As with cobalt, so with *tellurium*, a sister or, it may be, half-sister to sulphur and selenium. For years tellurium residues from certain mining processes have been hawked about university laboratories, looking for this same intelligence and persistence—and so far in vain. One of the very few tellurium utilities with which the writer is acquainted takes advantage of the exceedingly mephitic odor of one of its compounds. It seems that certain society physicians, through this substance, in the form of pills, are able to convey to the breath of patients upon whom it is desired to enforce rest and seclusion—a social impossibility—a truly dignified rôle for one of the eighty-odd elemental components of our universe! Out in Colorado, as a by-product of one of the electrolytic industries, many tons of beautiful, pure metallic tellurium lie piled as briquettes in beautiful inutility—elemental tellurium, absolutely unique in itself and throughout the full range of its compounds.

Still another element begging utility is *silicon*. In combination, it constitutes more than one-quarter of the crust of the earth; in its elemental condition it is produced at Niagara Falls to the bare extent of about four tons a day, useful for its deoxidizing power in steel manufacture, for the purpose of introducing electrical resistances in electrical circuits (for its resistanc is somewhat higher than that of carbon), and, potentially, I should say, for coating in the form of silicide the surface of large steel containers, or possibly even of acting as the actual substance of such containers. Were its utilities fully realized, it would doubtless be produced at the rate of four hundred tons a day.

Writing of pure elemental substances—there is chemically pure iron now produced by an electrolytic process. A pure metal is vastly different from a metal almost pure, and this pure iron (absolutely C. P. but for a trace of hydrogen) is certainly a novelty. The minutest traces of certain impurities may have, either for good or for bad, an astonishing effect. Having, therefore, a metal like iron, fundamentally pure, it may be expected that the addition of metals equally pure will lead to new alloys with new properties. At any rate, it thus begs utilization for unique industrial purposes.

Silver, again, is a metal that has its problems. The tarnishability of silver, particularly to people who live in the smoke-enveloped cities of the present day, is a time and muscle consuming annoyance. It is not surprising, then, that a prominent company manufacturing silverware should inquire as to the possibility of adding small quantities of other elements to silver, with the idea of lessening or eliminating its tendency to tarnish. So far as the writer is aware, no work of any kind whatever has been carried on with such an idea in view, and it thus certainly offers opportunities of distinct promise.

Possibly, of all the anxious inquiries coming in to this department, those pertaining to enamel are the most notable. It is extraordinary, the diversity of demands made by manufacturers for a really resistive enamel with which to coat their wares, and equally extraordinary is the entire inability of manufacturers of enamels to respond to their demands. One manufacturer desires an enamel for coating the malleable iron shells used on the Bunsen burners employed in incandescent gas-lighting mechanisms. The enamel used is destroyed by oxidation and by the ammonia and sulphur found in the gas. Another manufacturer desires an enamel resistive to the reagents used in photography; he manufactures

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

photographic machinery and photographic trays. Still another is desperately in need of a resistive enamel with which to coat his storage-battery cells. The art of enamelling cooking utensils is practised under medieval conditions of superstition and empiricism, and in no instance do these cooking utensils even remotely approximate the ideal. No enamel in the market intended for the lining of iron or steel containing vessels responds to the needs of manufacturers.

Another subject of inquiry almost equal in importance to that of enamels is that of bleaching agents. We have had to answer many and grievous letters of inquiry from manufacturers desirous of using bleaching agents which do not destroy the fabrics which they bleach. Here is one who manufactures annually some thirty million yards of antiseptic gauze, and here is another who desires to color unfinished yarn without bleaching. The plaint in each case is that bleaching destroys from twenty-five to thirty per cent. of the strength. One anxious inquirer makes horn buttons, and he finds, to his chagrin, that while he can perfectly bleach his buttons, after passing through the laundry *they revert to their original color.* In these and all other bleaching processes it may be said that there is no bleaching agent of an oxidizing character that does not injure the fabric upon which it is employed. Possibly sodium perborate is less injurious than any other.

Still another matter of much contemporary inquiry and anxiety relates to the increasing scarcity of wood—particularly the hard woods. Many men are to-day making and selling composition woods made out of wood-waste—for the most part sawdust. This sawdust is mixed with a binding material, and as such is finding its way into the market as flooring compositions. Still other men manufacture their composition wood out of waste wood-pulp from the paper-factories. Both types of manufacture have the regular tribulations of an unperfected process. Composition wood has an unquestionable future, but its success depends upon the discovery and utilization of a suitable binding material, and this I am sure has been found either in *bakelite,* that remarkably strong and resistive material discovered by Baekeland, or by *redmanite,* a different substance which is being developed in our laboratories at the University of Kansas. Apart from artificial wood, a great desideratum is artificial wood for special purposes. Thus, owing to the serious depletion of the cork-trees, an artificial cork is desired.

The art of paper-making, into which fifty per cent. of material of pine and hemlock passes, is, according to certain inquiries, by no means in a satisfactory condition. Owing to tariff conditions, actual and potential, and for other reasons, it is necessary now to make paper with qualities different from those that obtained in the past. Thus, a paper is now desired having a higher finish on a lighter weight and for a less cost; this is as yet an unsolved problem. Did the paper-makers but know it, the solution of the problems of paper manufacture and the provision of cheaper paper for all of us that print or read, lies in the transformation of the nitrogenous waste material and residues from the pulp-mills into valuable and utilizable chemical substances. It is incredible that in this age of progress fifty per cent. of the wood should pass heedlessly down the drains. Composition woods and imitation woods are hardly more desired than substitute woods. There is a certain company that uses immense quantities of maple; now, owing to the increased scarcity of maple, its cost has become prohibitive to that branch of manufacture. This company is persuaded that the common gum-tree of the Southern States, when properly treated, would yield a wood capable of substitution for maple, and it would express itself as under infinite obligations to any one who would demonstrate this free of cost.

The wood refuse from the sawmills, cornstalks, waste paper — indeed, all kinds of cellulose refuse are industrially convertible into denatured alcohol, and consequently many inquiries arrive as to the industrial value of such materials. For example, one gentleman in California has immense deposits of the sawdust of fir and of yellow and sugar pine, and all of it beside the way station of a railroad; naturally, he desired "to know a thing or two." The only hamperment

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

to the conversion of wood refuse into denatured alcohol is the fact that the process is at present in the hands of one corporation and its ramifying connections; if the holders of wood refuse will but "bide a wee" until such time when, through the exhaustion of an adequate gasoline supply, industrial alcohol becomes inevitable as the source of power for automobiles and other power-consuming mechanisms, they will find their material both useful and valuable.

Finally, in relation to this business of wood supply, there are fiber-making plants whose possibilities are hardly more than suspected. Down in New Mexico there is an immensely plentiful and widespread form of vegetation known as the yucca plant, or, vulgarly, as the "soapweed" or "bear-grass." This grass yields a fiber of remarkable tensile strength and quality. The only reason that the fiber-making possibilities of the grass have not been exploited is because it has not been properly investigated by men of scientific education and training. Consequently, when there is needed a suitable solvent for the gummy matter between the fibers or an efficient bleaching agent for the fibers themselves, the people interested in "bear-grass" are as helpless as babes.

Farther south, in old Mexico, there are people worriedly concerned with one of the rubber-trees of that region, the *Castilloa elastica,* as to the best method of tapping these trees and the subsequent management of the milk. In New York they are also worried about rubber, for they desire to print rubber sheets "as per sample, after the cloth has been finished"; it seems that the present printing of rubber rubs off.

One of the most interesting problems as related to fruits concerns the utilization of cull oranges and lemons. "Culls" are oranges or lemons that are deformed or over-ripe or under-ripe or that are slightly bruised. Out of the 30,000 cars of oranges shipped last year from California, the contents of at least 600 cars were thrown away. In Florida they cull at least 50,000 boxes a year, but the growers would gladly cull 250,000 boxes if they had but a profitable use for them. We have recently been highly honored by the Florida Citrus Exchange in placing with us, at the University of Pittsburgh, this problem for solution. We hope to succeed by preserving the juice of these waste oranges in such a way that it does not conflict in the slightest degree with the pure-food laws. We hope also to extract and utilize the oil which the rinds contain, the bitter principles underneath the rinds, and the citric-acid constituent of the juice itself.

But if the Western coast is interested in oranges, it is also interested in oysters. In far-away Seattle the oystermen are deeply concerned to utilize science to the furtherance of their business. The Western oyster is a curious little undersized creature, markedly different in its nature and in its ways from the oyster of the Eastern coast; for one thing, it is hermaphrodite. So different, indeed, are the two types of oyster that no knowledge gained of the Atlantic oyster is applicable to that of the Pacific. The Western growers desire not only to increase the output of the oysters natural to that habitat, but as well to transplant the Eastern oyster to the Western coast.

One of the most remarkable inquiries from the far West relates to a new use for a species of kelp or seaweed, abundant on the Western coast. Certain individuals have succeeded, through long experimenting, in emptying its cells and in extracting from the cell-walls its nauseating taste, in such a fashion that they have been able to refill the cell-cavities with food products and to make of the otherwise worthless sea-kelp a valuable food; they desire a market for their products, which are kelp-candies, jams, and pickles.

Another set of queries, wholly different from those that we have so far considered, concerns uses for raw materials. Despite the extent to which the raw materials of manufacture have been exploited and segregated in ownership, there still remain deposits valuable but not understood by the owners. Men wish to know what to do with large deposits of oil shale near Vermillion, Ohio. Some of this rock, a short time ago, caught fire and burned continuously for eight weeks. A lady in California possesses 350 acres of diatomaceous earth valuable for polishing metals, as mineral wool in cold-storage plants, in place of asbestos for steam-pipe coverings, as the "dope" for

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

the absorption of nitroglycerin in dynamite, in the manufacture of fire-proof brick, and for many other purposes; she wishes to know what she can do with it. Over in Utah there exist immense deposits of asphaltic substances whose uses, already manifold for varnishes, soaps, binding material, will be infinitely extended. To such an extent is this impressed upon certain men that they have established with us at the University of Kansas a research for this specific object.

Problems of manufacture in the traditional industries swarm in upon us—problems that a few years ago were not only not worried over, but were not known.

Is it possible to recolor and refinish leather? Certainly it is. In the process of chrome tanning, the flanks and shoulders of hides are flat, very, very flat, in the mineral tannage employed. The best answer I can give to such a question is that were I a young chemist seeking an *arbeit,* I should plunge into leather for a life's work. What science does not know about leather would fill volumes.

Shoe-blacking? How to color it, how to treat waxes to produce certain results, and how to arrive at certain results by combining waxes. Is it possible to improve the art?

Ink also has its troubles. A man wishes to dissolve Ghatti gum and at the same time preserve its adhesive properties. A lady writes from a town where the water is hard, suggesting that we should discover a hard-water soap—*i. e.,* a soap the curds of which in hard water would not stick to the sides of the bath-tub, as she says, "closer than a brother!" It merely means the discovery of a soap whose calcium and magnesium salts are soluble—a legitimate object of research with not improbably a successful ending.

Then there is glue; a certain manufacturer desires a water-proof glue for holding down the strips of artificial flooring to the floor. But this is a mere incident; as a matter of fact, if there is one substance of which we are densely ignorant, chemically, physically, and biologically, it is glue, and it is therefore a real pleasure to announce the establishment at the University of Pittsburgh of a fellowship for an investigation into the very fundamentals of glue, which, by the way, involve all colloidal chemistry, a new-born branch of chemistry that hardly anybody knows anything about.

Passing rapidly over announceable problems as they appear—the dentists are desperately in need of a cement that is "absolutely" insoluble in the mouth; manufacturers of toilet preparations need a method of compressing powdered pumice, for "mixing it with Portland cement is not satisfactory." The glass-makers are eagerly desirous of a method of manufacturing a ruby glass in the pots, for, as it is and always has been, the ruby color of the glass flashes out only on one or more reheatings—an expensive operation. A certain enormous manufactory of artificial cereals in packages is seriously concerned with the damage to these same packages by rats, and it desires, if possible, some method of making these packages distasteful to rats without conflicting with the pure-food laws. Another, equally huge in the extent of its manufacture and its operations, is embarrassed through the curious fact that while grasshoppers will have nothing to do with binder-twine made of imported flax, they avidly devour the domestic product, and with a consequent loss of a million a year to the company concerned, to say nothing of its loss of reputation among the farmers. Manufacturers of pharmaceutical preparations long ago found that they could preserve the widely used hydrogen peroxide by the addition of small quantities of acetanelide, etc., but now, under the slogan, "Let the label tell," they are embarrassed, never imagining that in all likelihood the decomposition of hydrogen peroxide is due to the catalytic influence of the small quantities of alkali in the glass of the containing vessels.

On the northern coast of Western America the shipping interests need an efficient anti-fouling and anti-corrosive paint for the hulls of iron vessels: they are at present paying $2.60 for one and $1.35 for the other, and the merits of both are "alleged." Science has still to discover a paint that, once on the hull of an iron vessel, will actually and truly prevent fouling and corrosion Very interesting is the desire of one company to utilize its vast deposits of fluor-spar in the

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

manufacture of hydrofluoric acid, the only objection to the wide-spread use of hydrofluoric acid being the melancholy fact that it attacks glass. On the basis of contemporary knowledge, however, it is easy to indicate methods of coating glass that would make it a safe containing vessel for hydrofluoric acid.

More numerous than any others are inquiries concerning varnish; literally, everybody everywhere demands better varnish. The blades of safety razors are a subject of some inquiry. The remarkably high price of a certain type of these blades suggests that the manufacturers thereof might readily afford an investigation into the steel out of which they are made, particularly with a view to making them a little less rustable. Why cannot the manufacturers of lubricating oils sell their product without admixture with animal fats, which, in certain types of engines, are exceedingly objectionable. They *will* mix in these fats to such an extent that it is almost impossible to obtain lubricating oils free from them. There is no thermo-couple used in industrial operations that is a satisfactory measurer of high temperatures; it is not surprising, then, that queries arrive as to the possibilities of research for the production of high-temperature thermometers.

The great business of transporting bananas, cocoanuts, and so on, from the West Indies, leads to the question as to what these transporting companies do with their immense quantities of banana trash, as well as to what use they put the husks of cocoanuts. The question is easily answered; they do nothing; and yet this banana trash is a valuable product, and the husks of cocoanuts have at least paper-making possibilities. The people of America have been so busy buying essential oils and perfumes from Europe that they have not as yet realized that many plants indigenous to their own country possess oils of high value whose extraction would be profitable; at present these plants cover the fields and forests, only to sink back into the soil. Let the reader who has naturally an interest in such a subject look up the price of oil of wintergreen, and then let him speculate as to why he should not plant the berries of the wintergreen under his own hardwood trees, and annually thereafter distil the oil from the resulting cut plants; nobody as yet has tried to do this. The present practice is the old practice—that of sending out people over the countryside who ruthlessly pull up the plants and extract the oil by means of portable stills—naturally an expensive and destructive process.

Among so many inquiries, it is inevitable that there should be some stamped with the hall-mark of the old-time "inventor." I am recommended, for example, to a certain mud as a sure cure for rattlesnake bite, and to the exploits of a certain ancient tramp of Iowa who is able to burn out cesspools with a pinch of powder. One earnest "inventor" has a method of removing the rind of potatoes, the loss of which in kitchen practice exceeds seventeen per cent.; another desires to make a shaving cream instead of soap; still another has "invented" a method of obviating the necessity of "licking" postage-stamps and envelopes; while a gentleman in the North is "positive" that the study of arteriosclerosis would eliminate old age and death. Why do not these ingenious people realize that solid opportunities for wealth lie everywhere at hand? Consider the fact that it is only necessary to bore a small depression in a phonograph record at the end of the script to insure that the needle will stop the machine without the necessity of nervously waiting to "turn it off"; since the phonograph people do not know this, it should be "worth money" to their informant.

The many and important actual opportunities that lie everywhere at hand for applying scientific knowledge and the scientific method to the manufacturing needs of men make one frankly consider why trained and earnest men should devote laborious days to making diketotetrahydroquinazoline or some equally academic substance, while on every side these men are needed for the accomplishment of real achievement in a world of manufacturing waste and ignorance.

The inquiries listed above are but a fraction of those that we might disclose. They are illustrative and significant of the transformation that is sweeping over American industry.

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED

Comrades

BY ELIZABETH STUART PHELPS

IN the late May evening the soul of summer had gone suddenly incarnate, but the old man, indifferent and petulant, thrashed upon his bed. He was not used to being ill, and found no consolations in weather. Flowers regarded him observantly—one might have said critically—from the tables, the bureau, the window-sills: tulips, fleurs-de-lis, pansies, peonies, and late lilacs, for he had a garden-loving wife who made the most of "the dull season," after crocuses and daffodils, and before roses. But he manifested no interest in flowers; less than usual, it must be owned, in Patience, his wife. This was a marked incident. They had lived together fifty years, and she had acquired her share of the lessons of marriage, but not that ruder one given chiefly to women to learn—she had never found herself a negligible quantity in her husband's life. She had the profound maternal instinct which is so large an element in the love of every experienced and tender wife; and when Reuben thrashed profanely upon his pillows, staring out of the window above the vase of jonquils, without looking at her, clearly without thinking of her, she swallowed her surprise and tolerantly thought:

"Poor boy! To be a veteran and can't go!"

Her poor boy, being one-and-eighty, and having always had health and her, took his disappointment like a boy. He felt more outraged that he could not march with the other boys to decorate the graves to-morrow than he had been, or had felt that he was, by some of the important troubles of his long and, on the whole, comfortable life. He took it unreasonably; she could not deny that. But she went on saying, "Poor boy!" as she usually did when he was unreasonable. When he stopped thrashing and swore no more she smiled at him brilliantly. He had not said anything worse than "damn!" But he was a good Baptist, and the lapse was memorable.

"Peter?" he said. "Just h'ist the curtain a mite, won't you? I want to see across over to the shop. Has young Jabez locked up everything? Somebody's got to make sure."

Behind the carpenter's shop the lush tobacco-fields of the Connecticut valley were springing healthily. "There ain't as good a crop as there gener'lly is," the old man fretted.

"Don't you think so?" replied Patience. "Everybody says it's better. But you ought to know."

In the youth and vigor of her no woman was ever more misnamed. Patient she was not, nor gentle, nor adaptable to the teeth in the saw of life. Like wincing wood, her nature had resented it, the whole biting thing. All her gentleness was acquired, and acquired hard. She had fought like a man to endure like a woman, to accept, not to writhe and rebel. She had not learned easily how to count herself out. Something in the sentimentality or even the piety of her name had always seemed to her ridiculous; they both used to have their fun at its expense; for some years he called her Impatience, degenerating into Imp if he felt like it. When Reuben took to calling her Peter, she found it rather a relief.

"You'll have to go without me," he said, crossly.

"I'd rather stay with you," she urged. "I'm not a veteran."

"Who'd decorate Tommy then?" demanded the old man. "You wouldn't give Tommy the go-by, would you?"

"I never did—did I?" returned the wife, slowly.

"I don't know's you did," replied Reuben Oak, after some difficult reflection. Patience did not talk about Tommy. But she had lived Tommy, so she felt, all her married life, ever since

PRODUCED BY UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED