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WAR TIME INVENTIONS

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In the wake of the terrific explosions of atomic bombs which were destined to wipe Japan out of existence and which actually advanced the end of this war, more than ever we feel pride and reverent awe before the greatness of human mind and its achievements. However, a number of other, less spectacular but not less important, war developments have been made known to the public during the recent years. Among them perhaps the most prominent place belongs to the tremendous development of industrial electronics, radar and plastic materials as substitute for metals.

But in the background of these wonders disquieting questions loom in many a mind: Do we really need a war to promote inventions? Are hatred and destruction more inspiring than peaceful purposes? Are progress and civilization to be always energized by wars?

Fortunately even a superficial study of the past inventions and scientific discoveries would give us negative answers to all these questions. The apparent role of wars in this respect, especially of modern wars of technics, is to enhance and accelerate developments already on schedule, by almost unlimited spending of money and by diverting the best minds and skill into war channels. In the absence of wars the same inventions would become available to human uses at a somewhat slower rate but undoubtedly in a more economic and humane way.

The fact is that very seldom, if ever, does an invention or a scientific discovery come out of a clear sky. Neither do they critically depend on individual minds credited with each particular invention. If humanity is ripe to assimilate a new useful idea, it will get it under any circumstances

through one or another channel. One may imagine that new ideas are at all times, so to say, floating in the air and are picked up by those minds which are more closely atuned to them, either because of their specific education, or line of work, or efforts, peculiar inclinations, etc. This is not unlike receiving antennas intercepting a radio message from the air. Just as several antennas can record the same message, practically every great invention and discovery has been and always will be made by several individuals, often separated by a great distance and knowing nothing about each other's work. This can be illustrated by numerous examples.

Thus, calculus of infinitesmal quantities, a powerful mathematical tool of modern science and engineering, was "thought of" simultaneously by Newton in England and by Leibnitz in Germany.

The discovery of the similarity of the nature of lightning and of the electric spark produced in a laboratory, without question credited to Benjamin Franklin, was also made independently -- in fact two years earlier-- by Michael Lomonossoff, one of the early presidents of the Russian Academy of Science founded by Peter the Great 220 years ago.

Laws of electromagnetic induction, the basis for designing modern electric machinery, were established independently, several years apart, by the great Englishman, the son of a blacksmith, Michel Faraday, and by an American professor, Joseph Henry of Princeton.

The incandescent lamp which revolutionized our domestic and community life is customarily credited 100% to Thomas Edison, while actually incandescent lamps had been built by a score of inventors prior to and simultaneously with Edison, all over the world. The great merit of Edison lay in an ingenious combination of five important already known features in one device, thus rendering the lamp commercially available to the public.

Radio, the invention of which is without restriction credited to Marconi, was independently invented one or two years earlier by a Russian professor, Nicholas Popoff, too timid for its commercialization.

Finally, the basic idea of television systems employing the Cathode Ray tube instead of previous mechanical devices (such as the Nipkov disc), though rightfully credited to Dr. Zworykin and to Farnsworth in this country, had been suggested 25 years earlier by Campbell Swinton in England and by professor Rosing at St. Petersburg, Russia.

One can continue similar stories almost indefinitely. One moral implied by these examples is that no inventor should be too proud of himself as surely, if not through him, the same invention would be brought about through someone else. He must be rather humble and grateful for being permitted in preference to other fellow-inventors to become a practical channel for the flow of beneficial ideas.

Whatever is said about inventions in general is of course applicable to our present war inventions. Indeed, atomic energy had been discussed for years before the war. In 1938, two German scientists, Hahn and Hasselman approached a scientific solution of releasing atomic energy from uranium atoms. This was further advanced by Hahn's associate, Lisa Meitner. Then, a group of our scientists and engineers employed by our Government, after several years of hard work, developed practical methods of obtaining this energy in large quantities to our enemy's detriment. We, however, must keep in mind that in this case perhaps by a narrow margin we escaped being on the wrong side, as Germans were very close to the solution of a similar problem; the events happened in our favor only due to the properly and timely organized work and to the concentrated efforts of many.

Another important war invention, radar, also did not come by magic during the war. When, a year and a half ago, this secret topic was in part released by our Services, practically every self-respecting concern dealing in electronics made strong claims of being contributors, if not the originators of radar. The fact is that radar was not the fruit of thinking and labor of a single mind. Long before the war, several members of our Naval Research Laboratory conceived the possibility of radar while experimenting with so-called ultra-short radio waves, because of their properties of being reflected from various objects back to the sending point. About the same time, world wide experimentation with "short" waves was started as these waves, it had been found, with little power could carry radio messages around the earth, because of their reflection from the hypothetical electric ceiling in the atmosphere several hundred miles above our heads. Its existence had been postulated by a British scientist, Heaviside and an American professor, Kennally in 1903. General study of short wave reflection from this ceiling resulted in the development of a method of measuring extremely short intervals of time between sending a wave train and its return after reflection. This became another important factor in the development of radar. Furthermore, about the same time, in anticipation of television needs almost universal work was started on the development of electronic tubes capable of generating powerful ultra-high frequency oscillations. This was the third contributing factor for the realization of radar.

The third sensational war development, industrial electronics, consists in application of electronic tubes to numerous industrial processes. This was conspicuously the result of combined efforts of thousands of intelligent workers. Again, the war did not start it but intensified efforts to utilize

the wonderful properties of the electron tube for many new branches of industry with the specific purposes to accelerate production of many types of goods and to increase precision of manufacturing processes, often disregarding the cost. Contrary to the prevalent common belief, "Electronics", as a branch of engineering and science dealing with electronic tubes, was not started in 1905 or thereabouts with Fleming's invention of the first electron-tube detector of radio waves (Fleming valve), neither with the ingenious three electrode tube of Lee deForest. The actual fact is that non-radio electron tubes and their applications by far preceded those of radio tubes, and the study of electron tubes (without calling them by that name) was started about 250 years ago. Indeed, since Otto von Guericke's invention, 300 years ago, of his primitive vacuum pump and electric friction machine, scientists all over the world were in a position to produce and study the colorful phenomenon of electric discharge in evacuated glass tubes. In the old literature one can find descriptions of such experiments as early as 1705. However, the actual scientific and practical study of electric discharge in evacuated tubes was begun during the 1870's enhanced by greatly improved vacuum pumps (Geissler mercury pump, 1864) and the invention by Faraday of the induction coil, improved by Rhhmkorf, as a source of high voltage, also by the fundamental work of Wilhelm Hittorf in Germany and of the brilliant British chemist, Sir Willian Crookes.

The first practical result of this general study of Crookes' tubes (known also as Hittorf's or else Geissler's tubes) was the invention of the Roentgen or X-ray tube (1895) and of the Braun of Cathode-ray tube (1897). The first one has since been well known in medicine and surgery, but during recent time it found a wide application in industry for radiographic investigation of castings and welded machine parts. The Cathode-ray tube is now indispensable in

many industrial applications of electronics, and constitutes the heart and soul of every television and radar system.

The other early and important electron tube was the mercury arc rectifier invented by Cooper Hewitt in this country, 1902. Further developed in this country by the Westinghouse and General Electric engineers, then, in Germany. It is widely used for conversion of large quantities of a-c electric power as generated by powerful alternators into the d-c form which is more suitable for operating street cars, suburban railways, steel mill motors, etc. Several modern versions of the mercury arc rectifiers, such as the Ignitron of Dr. Slepian (1932), the Thyratron of Dr. Albert Hull (1928), the Excitron of the Allis Chalmers Company (1944) are par excellence responsible for the wide growth of Industrial Electronics during the war time. This is greatly helped by a tiny, but extremely important member of the family of electron tube, the photocell existing for about 50 years.

Not much can be added to the widely known important role of the electron tube in radio. Enough to reiterate that it made radio-telephony hence, of the art of broadcasting, possible, the role of which - good and bad- in modern civilization cannot be overemphasized. Now it is ready to start on the same path the Television.

In conclusion, we should perhaps try to answer another disquieting question regarding war inventions. Will not all these highly perfected tools lead to the ultimate mutual destruction of our humanity, or maybe of our very planet? Who knows,--those mysterious 1000-odd asteroides, the remnants of an ancient planet between Mars and Jupiter,--are'nt they perhaps silent witnesses of a gigantic strife among some ultra-ancient races, which, like ourselves, knew how to produce but not how to control atomic energy? The answer seems to be clear:

Basically, there are no good or evil inventions, but there are good and evil intentions; also, beneficial or destructive uses. One can easily imagine atomic energy in the service of humanity as highly concentrated fuel, as the moving force of vehicles, even as a means of interplanetary communications, and what not. Radar surely will be immediately applied for increasing safety of aerial and surface communications (remember the recent Empire State disaster). Finally, Electronics may enter every detail of human life, domestic and communal for saving labor and increasing our comfort.

But how can one compel humans to make the proper choice and to apply inventions to the good, not to destruction of humanity? There is only one general solution: Without relinquishing Civilization as expressed in many wonderful inventions and modern economic ideas one must immediately start and fulheartedly pursue Cultural education of individuals from the top to the bottom of humanity. The word Culture means "bringing light", light not of ingenious electric devices but Spiritual Light. By way of paradox one can formulate the cause of all modern sufferings of the human race as the lopsided promotion of material Civilization while nearly nothing is being done for the promotion of Culture.

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