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AND ATOMIC ENERGY

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Prevented only on that day of it, as on December 1948, the High Commissioner and all his colleagues were rightfully proud: France had just cleared a new step.

While at Chatillon, they were utilizing the pile and they were building some equipment, while in France and abroad prospectors were searching for and finding uranium, the Center of Nuclear Studies of Saclay began to be constructed: the second pile and two accelerators were going to be installed there.

March 19, 1950, Frederic Joliot-Curie is fifty years old, but he is that day in Stockholm.

April 6, at Montreuil, in the course of a monstrous banquet, his friends, his comrades celebrated this birthday.

His closest collaborators in the heart of the Commissioner's Office in Atomic Energy decided to concoct again in the course of an amicable dinner. After several investigations about the place and several hesitations on the date, rendezvous was set for April 26 in the evening at the "Popote des Ailes," in Viroflay.

With the commissioners, directors and branch chiefs is the physicist Bruno Pontecorvo, one of the former (students) of the College de France "and one of the preferred pupils of Joliot."

The program was pleasant, the menu plentiful and of good quality, the wines excellent--all things to which the High

Commissioner has always been very sensitive--and the atmosphere very gay.

Yet, in the speech that Joliot delivered at the end of that evening, some words--understandable for some scarcely initiated--showed that the future was not without him to arouse serious preoccupations.

This same day, in the afternoon, Frederic Joliot-Curie had been summoned to Varenne Street to the President of the Council's resident. Introduced in the office to Mr. George Bidault, he heard the latter tell him:

> --Before taking a sanction in your regard, the administrative rules require me to make communication to you of your file.
> --That file, here it is...

And with a gesture, the president of the Council indicated effectively a straight-jacketed shirt: on the cover, the name of the High Commissioner in Atomic Energy, on the inside his enactment of nomination. And it is all!... But all around the file, the minister's office was covered with clippings from newspapers...

The president expressed his regret of having to take such a measure.

> I am going to lose your friendship after having lost that of Yves Farge.

It is unquestionable that the very visible emotion of Mr. George Bidault was not make-believe and that the former president of the National Council of the Resistance, dismissing from his post the famous scientist, the former president of the

National Front, was measuring fully the significance of the "duty of State" which he felt obliged to perform.

It is the statement made by F. Joliot-Curie to the Congress of the French communist party, April 5, 1950, which had furnished the occasion of his countermanding. The following passages were particularly accused:

> The imperialists wish to launch a new war against the Soviet Union and the popular democracies.
>
> . . . . . .
>
> While struggling against the war of aggression which is being prepared, I think about all those scientists who are helping a science in the service of the people, who are giving us a magnificent example. I think about all those new men who have rescued the world and who are the hope of the world. It is why never the progressive scientists, the communist scientists will not give a portion of their science in order to make war against the Soviet Union. And we will hold firm, sustained by our conviction that being a question we serve France and humanity completely.

In addition to this precise declaration, it was made the condition in order to motivate the dismissal of Joliot with his "acceptance without reserve of the resolutions passed by the Congress of Gennevilliers of the French communist party."

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The crisis which has thus just burst throws out a revealing light on the profound meaning of the whole existence of Frederic Joliot-Curie.

The dismissal of April 29, 1950, is the outcome of a long series of tensions and manifestations which became perceptible since before the birth of ZOE, which were enlarged considerably to that moment and which could not fail to attain their objective unless a reversal of the political line followed by the actual

leaders of France.

Since 1947, in certain regions industrialists and financiers, manifested a very curious reserve in regard to the Commissioner's Office in Atomic Energy. "They observe you, they are looking at what you are doing," one day replied a high person in industry at the time of a measure carried out near it (industry) in view of the recruiting of specialized personnel. As the work goes on the Commissioner's Office was developing itself, more numerous became those who were astonished to see at its head a scientist who is also an engineer, who was not taking part with this large family of old polytechnicians and who, in addition, was allowed to be a communist.

March 18, 1948, while the preparations for the test of the first French pile were going at a quick pace, a first and violent incident burst in the Council of the Republic.

But the ground was not yet fertile and the vote of the Council of the Republic was favorable to the High Commissioner (83 votes against 79), but with a considerable number of abstentions.

This same March 18, by a curious coincidence, Irene Joliot-Curie, equipped nevertheless with a visa for the United States, saw herself refused entrance to New York, was detained several days at "Ellis Island," with the local banishments, before being admitted finally before general protests.

The success of the putting in operation of ZOE unleashed a genuine blizzard of articles, and, from this moment, the tension will scarcely relax.

The tone was furnished by the American periodical Time Magazine which was entitled "A Communist pile."[1]

The British Economist printed December 25, 1948:

> A certain uneasiness is had presently in the United States in front of the prospect of most pushed investigations in this domain (atomic). Atomic research in France with the participation of the communists, would be not easily compatible in the long run with the military commitments of France at the heart of the Western Alliance or of the Atlantic Pact.

And the New York Herald Tribune (European edition of December 27, 1948, beneath the signature of Stephan White):

> ...The existence of the French pile is a genuine menace for the measures that the nations of the English-speaking world have judged well to adopt. For very many, the menace is still greater from the fact that the director of the French works, Dr. Frederic Joliot-Curie, is an avowed communist.

And one could multiply the quotations of this kind. The basic bitterness which was made, with a certain authentic fact, was that of the end of the Anglo-American monopoly in material of atomic energy at the heart of that which it is convenient to call the "western world."

As for the fear displayed over the subject of vital secrets, it could not construe a genuine uneasiness.

The Commissioner's Office in Atomic Energy was a civil establishment, uniquely devoted to technical or industrial scientific research. Against secrecy in matter of basic science, Joliot had a firm and unchanged position always. It is the one that he had the occasion to reaffirm in 1939, in response to the course of Leo Szilard.

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[1] "Une pile communiste."

For the "technical or industrial secrets," his position was likewise clear and moreover evident. However, in front of the stirrings (of passion) provoked by the success of ZOE he held to put things to the point and he chose to do it January 5, 1949, at the time of the luncheon which was extended to him by the Anglo-American press:

. . . . . .

> From the very first, the results of the basic research that we will obtain in this domain will continue to be published and thus, all the countries of the world, the U.S.S.R. included, will be able to profit from it.
>
> In that which concerns the results of practical research obtained certainly in view of the peaceful applications, but which would be susceptible to murderous applications, it seems to me necessary to keep them secrets so much that the weapons of mass destruction, as the atomic bomb, will not be put before all outside of the law by the United Nations Organization.
>
> A French communist, as any other French citizen, occupying a post which is entrusted to him by the government, cannot honestly think to communicate with a foreign power whatever it be of the results which are not related to it, but which concerns the community which has allowed to work. No matter which communist has consciousness perfectly of the necessity of this conduct.
>
> Let us explain frankly. If one of my co-workers or myself found tomorrow a basic result for the production of atomic weapons, the authors of articles cited above suppose that our task--voluntarily accepted--would be to communicate all the details of it to the government of Moscow. We are committing therefore, it seems "intentionally" the crime of treason and it would be suitable to punish us for it in advance. On which facts rest such an accusation? To absence of facts, on which premises can one build this absurd reasoning which leads to believe that being a communist relieve you morally of the French nationality and transforms you automatically into a well-disposed and remunerated spy?

. . . . . .

> Certainly, the communists, and not only the communists, feel a great admiration for the Soviet work, as many

citizens, at the time, were turning with hope toward the revolutionary France of 1792.

. . . . . .

Republicans who, in their respective countries, were fighting social injustice and monarchy, were not they already treated "as agents of France." And yet they were pure and authentic patriots. As the republicans of that period, with all the progressive elements, we wish to militate in our country in the framework of our democratic constitution in order to establish more social justice and more prosperity, conditions that we consider as being favorable to the peaceful organization of the socialist world.

Three and a half months later, he took a new position with regard to the eventuality of the fabrication of an atomic bomb by France. On April 23, 1949, at the "National Conference of the Movement of French Intellectuals," he declared:

I think that, in order to defend peace peacably and effectively, we must indicate this wish by acts, engagements which necessitate courage. It is not sufficient to say: I am for peace. It is easy, that! That commits no one. All the world is in agreement with it!

On the contrary, he is a precise and effective commitment that we can, that we must take: if, in our professions, they ask us, as that happened to me in the domain in which I work, if tomorrow they ask us to do work for war, to make the atomic bomb, we answer: no![1]

This is a commitment and we will hold it. That can, indeed, have inconveniences, and for certain ones, their position can find itself diminished for it; for others, that can be more grave still. We have seen it in the United States, where men lose their position. Well! we must help them, because it is also a form of acting. Those who have not had the occasion to take yet a position must help those who have taken it and who can go through the consequent hardships of it.

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[1]It is interessing to reapproach this text from the opinion expressed by P.M.S. Blackett on the subject of the dismissal of Joliot (Biographical Review, 1960, p. 100).

"This came about not only at a moment of great political tension resulting from the war of Korea, but in a period in which the French government modified the original objective of the French atomic organization, which initially ought to preoccupy itself solely with the industrial and scientific aspects of atomic energy, and decided to construct atomic bombs."

The frontal attack having however run aground, they managed to reduce the credits attributed to the Commissioner's Office in Atomic Energy, not without letting to understand that with another chief at its head, the position could be re-examined.

But reactions manifested themselves still with promptness and vigor. In particular, the Academy of Sciences assembled in secret committee April 11, 1949, adopted unanimously a desire very energizing transmitted to the government.

The visit of Frederic Joliot-Curie to the U.S.S.R. in November 1949 and his statement before the Academy of Sciences of this country, the anniversary of ZOE, served as a base in a resumption of attacks, whose meaning was rendered clearer by a statement of the president of the United States following:[1]

> The government of the United States will seek, in the near future, to assure control of the production of uranium in all the regions of the world which are not under Soviet influence.

An examination, even rapid of this group of facts and of documents shows well that the declaration of Gennevilliers--which, moreover, in condemning an eventual war of aggression remained consistent to the letter and to the spirit of the Constitution of the French Republic--served as a pretext to eliminate F. Joliot-Curie from a post of director in which he had technically and objectively succeeded, all in making the "great mistake" of expressing on general problems not very conformist opinions. The Catholic writer Louis-Martin Chauffier summed up, at the time, very well the situation:

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[1] Le Monde, October 1, 1949.

> Joliot had much science and integrity. He worked well and refused to yield. They are driving him away: it is in the established order.

As for the direct co-workers of Frederic Joliot-Curie, Francis Perrin, commissioner, L. Kowarski, B. Goldschmidt, J. Gueron, directors and nine branch chiefs, they affirmed on April 28, 1950:

> Contrarily to an opinion unfortunately too propogated, the Commissioner's Office in Atomic Enery is not an establishment of national defense, and we think that the post of High Commissioner does not imply any restriction of the right of expression of its holder.

It is thus very essentially the "communist" that they had decided to strike. It was not possible in the eyes of the French leaders to allow demonstrating by experience that a man having these convictions could succeed in his job and serve effectively his country. Additionally, it is logical to think that the worry of giving pledges to the Americans in view of the hope--always disappointed--of getting "atomic secrets" from it would equally interfere.

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In the course of the years which followed this dismissal, numerous harassments were inflicted on Frederic Joliot and on Irene Joliot-Curie.

In 1955, under the pressure of public opinion, an unquestionable relaxation is manifested in international relations. Scientists, of whom many had struggled to this effect since 1946, are going to be the first and theoretical beneficiaries. In Geneva, in July 1955, the "atomists" of all countries will meet each other. Americans, Russians, Englsih, French, Indians, etc... are going to discuss together subjects up until then

maintained taboo. The delegation organized by the French government is very numerous and the exhibition which it will present will take back a great success. But to the general surprise, the discoverers of artificial radioactivity, of the fission of uranium, of the chain reaction... do not take part at all. At the time of the press conference of Mr. Francis Perrin, a foreign journalist was astonished at the absence of the two French laureats of the Nobel Prize in Nuclear Chemistry. The reply could only be embarassed: "The French government has not judged their participation necessary."

The government went further: the names of Frederic and Irene Joliot-Curie were removed from all the panels of the French exhibition. By contrast, these names figured in a good place on those of the British exhibition.

Several countries had manifested the desire that Joliot be invited to give one of the large public lectures of the evening. The French delegation decided not to withhold this offer. The responsible ones of these decisions knew well however that they would not succeed in blotting out history...

The university personnel, to the contrary, had held, a year before, to celebrate with splendor, at the Sorbonne, the twentieth anniversary of the discovery of artificial radioactivity.

To all this had just been added the small individual manifestations: colleagues who are turning away, fleeting glances, handshakes avoided, communications interrupted or spaced. On the other had, less sensitive that Joliot, would have suffered less of it. All these which attacked him in the course of these

years can attest to his sadness and his bitterness. One of his pupils, Pierre Radvanyi, reports:[1]

> Joliot has been able to say in a moment that the number of those who were coming to him to squeeze his hand and to speak to him in the course of reunions at which he was present, represented for him a very sure barometer of the international situation.

Certainly, in the opposite direction, the evidences of sympathy of his pupils, of his known and unknown friends arrived by the thousands, from France and from foreign countries. Numerous manifestations of protest took place somewhat everywhere. On May 5, 1950, at eleven o'clock he made his usual way to the College de France into an amphitheater completely filled, the long earthenware table intended to receive apparatus disappearing that day under bouquets of flowers. After that, standing, all the amphitheater began to sing "La Marseillaise," the former High Commissioner in Atomic Energy, his voice gripped by emotion, announced that he was going to discuss transmutations provoked by charged particles. He allowed himself, however, some brief preparatory remarks. After having brought to mind certain "disturbances occurring at the head of the Commissioner's Office in Atomic Energy," he cast a cry of alarm to his hearers on the subject of the terribly insufficient trust authorized to science.

> Science is indispensable to the country. A power justifies its independence only by what it brings to others of originality. If it does not do that, it will be colonized. It is by patriotism that the scientist must develop his ideas and enlighten his fellow-citizens on the role of science, which must free mankind, and not serve to increase the particular profits. If the

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[1] La Pensee, No. 87, 1959, p. 84.

scientist does not have a certain courage, how will he justify his presence in the laboratory? It is politics, will they say? But politics is a good thing that we wish to discredit for bad reasons.

VI

DEFENSE OF SCIENCE AND OF PEACE

By his general reflections, by the nature even of his research, by the conversations that he had been able to have with Madame Curie, Paul Langevin and other colleagues, Joliot was particularly sensitive to all which concerned utilization of discoveries and inventions.

In the spring, and in the summer of the year 1945 veered to unfold events which came pose before the conscience of all men and more specifically before that of scientists, the whole of the problem of the social implications of science.

On May 8, 1945, the war had come to an end in Europe. It was still continuing in Asia, but its outcome was no longer uncertain. It is then that the terrible weapon appeared.

On August 6, 1945, the large airplane Encolay Gay unfurled at 8:15 in the morning an atomic device on the Japanese town of Hiroshima. Several kilograms of uranium-235 anihilated one hundred thousand persons.

On August 9, 1945, the airplane Grand Artiste dropped a plutonium bomb on the port of Nagasaki. Seventy thousand victims...

The atomic era was opened, for humanity, under those terrible auspices.

Few men could, at that time, imagine the nature of the atomic bomb and measure the repercussion of its utilization in war. Certain scientists, as the German physicist W. Heisenberg, resisted for several days to think that it could be a matter of a liberation of the energy accumulated in the nuclei of atoms.

They held out well to yield to the evidence. As for Joliot, his personal contribution to the basic discoveries on fission as well as the fragmentary information that he had been able to receive did not allow him to doubt for a single instant.

August 10, 1945, the day after the bombing of Nagasaki, he drafted a detailed article which was published in the newspaper L'Humanite of August 12, 1945.

> It is also correct that the immense reserve of energy contained in the uranium machines can be liberated rather slowly in order to be utilized practically in the well-being of mankind. Personally, I am convinced that despite some provoked sentiments, by the application to destructive ends of atomic energy, this will render to men in peacetime, unestimable services.

After having revived the historical account of atomic research, he concluded:

> If one must admire the gigantic effort of research and production realized by the United States, it does not remain less true of it that it is in France that the first sources of realization have been found; they constitute a contribution of first importance in this new conquest of man over nature.

The war came to an end in Asia likewise. But to the relief and to the hope came progressively to superimpose itself uneasiness, then distress caused by the consequences of what had just been accomplished.

It was natural--and it is what happened--that scientists were the first to realize the intensity of the menace. Only the Americans, at the time, were in the stream and it is they who reacted first and in an excellent way.

On June 11, 1945, more than a month before the experiment of Alamagordo,[1] a report established by a committe of seven American scientists, presided over by Professor James Franck, was conveyed to Mr. Stimson, Secretary of War of the United States.[2] This report, of an outstanding importance, declared itself emphatically against the eventual utilization of the atomic bomb in the war against Japan.

> It will be very difficult to persuade the world that a nation, capable of preparing secretly and utilizing suddenly a new weapon so blindly that the fuse and a thousand times more destructive, can be believed when she proclaims her desire to see such weapons abolished by international agreement.

After having recommended a public demonstration on a deserted island, the report concluded:

> We believe, by virtue of these considerations, to be able to dissuade the utilization of the atomic bomb for a next attack against Japan. If the United States would be the first to launch this new means of blind destruction of humanity, they would renounce all moral backing in the entire world, would accelerate the course to armaments, and would hurt the possibility of leading to an international agreement on the final control of such arms.

Sixty-four other American scientists, in a petition addressed to President Truman, declared themselves in the same opinion.

Gradually as the documents relative to the period which immediately preceded the bombings of Hiroshima and Nagasaki were made public, the significance of the decision of the

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[1] It is at Alamagordo, in the desert of New Mexico, that was tested, July 16, 1945, the first atomic bomb.

[2] This report was published in May 1946 by the Bulletin of Atomic Scientists of Chicago. The subscribers, in addition to J. Franck, were L. Szilard, E. Rabinovitch, D. Hughes, T. Hogness, G. Seaborg, C.J. Niekson.

government of the United States to proceed to these (bombings) became more and more clear and more and more alarming for the future. It is not military reasons, but diplomatic grounds that had justified this decision. At the termination of an exhaustive analysis of all the known documents, the British physicist P.M.S. Blackett, holder of the Nobel Prize, was led to conclude:[1]

> As far as our analysis has been able to guide us, we have found no military reason compulsive to the decision visibly very premature of hurling the first atomic bomb on August 6. But we can discern a very compulsive diplomatic reason, pertinent to the equilibrum of the powers in the post-war world.
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> . . . . . .
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> Thus, in truth, we are concluding that the dropping of atomic bombs has not been in such a manner as the last military act of the second World War, that the first act of a diplomatic cold war which is unfolding at present with Russia.

In Europe, then in the entire world, scientists would not delay in deducing the consequences of this mass of facts and circumstances.

After the liberation of Paris, Joliot had several renewals the occasion to go to London. Since before the explosion of the first atomic bomb, he received, for Irene and himself, an invitation to go to the United States. A military American plane took them to Paris and put them down at first in London where they waited several days before learning that their trip had been canceled. The same military plane brought them back to Paris, but the crew appeared in the return immensely less

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[1] P.M.S. Blackett, Military and Political Consequences of Atomic Energy, London, 1948, pp. 123, 127.

deferential... They learned later that the security branches had feared lest the two French scientists ask to meet American colleagues engaged in atomic research in which case it would have been impossible to explain the true reason for which they could not be conveyed.

In London, Joliot had experienced a great joy in finding again about the extraordinary animator that Louis Rapkine was, a group of French scientists who, throughout the war and thanks to Rapkine, had been able to escape from France and reunite in Great Britain, in Canada, or in the United States. He found again likewise several members of a French-British group of scientists established before 1939 in view of developing scientific cooperation between the two countries. It is moreover in the midst of this group that he had already been acquainted with Lord Suffolk, well before their meeting of Bordeaux.[1]

It was also conversations with certain members of the "British Association of Scientific Workers," which was organized, in February 1946, a lecture dealing with the following theme: "Science and the Well-being of Humanity." Scientists in origin from nine different countries were present, and it is in the course of these debates that germinated the idea of the creation of an international organization of scientists.

The British Association was in charge of preparing a plan of establishment and, in London, on July 20-21, 1946, was held the meeting at the end of which was created in enthusiasm, the

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[1]Among the British members of this group are mentioned Bernal, Blackett, and Zuckerman.

"World Federation of Scientific Workers" (F.M.T.S.).

Three days later, still in London, the executive council of the new federation met again and chose its president: Frederic Joliot-Curie.[1]

This period of the year 1946, which was going to lead to undertaking an action long overdue in the opinion of his colleagues of the entire world, Joliot brought it to mind in the message which he addressed to the federation at the time of the celebration in Peking,[2] in 1956, of its tenth anniversary.

> When in 1946 the first backers of this world organization of scientific workers were convened, humanity was scarcely emerging from a ghastly nightmare.
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> . . . . . .
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> In the last hours of this terrible conflict the atomic bomb appeared. Its power of destruction, the true reasons of its utilization at Hiroshima and Nagasaki--against the advice so clear--sighted of many of our colleagues of the United States--were posed directly to humanity of new problems at the same moment when all ought to have united men in common will of reconstruction and brotherhood.
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> All the delegates at the inaugural conference of London, as at the first executive council of Paris, and all the scientists that these delegates were representing, experienced strongly the feeling that the more yet that by the past the rapid development of science and its applications were going to pose difficult problems on which it was impossible for conscientious scientists with their reponsibilities keep silent.

Far from him the thought of escaping these responsibilities that he had investigated. He felt himself more directly concerned than the others by the problems that the existence of

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[1]This presidency, he will assume with authority and zeal, until 1957; it is the British scientist, C.F. Powell, likewise holder of the Nobel Prize, who would succeed him.

[2]Joliot has always fondled the dream of going to China. Invited on numerous occasions, he could not unfortunately realize it. But in Vienna, in 1952, in the course of an executive council, he had the joy of seeing again his pupil Tsien San-tsiang.

the atomic weapon is posing to humanity, because his research has directly contributed to it. It was normal likewise that he is wondering one day how (he) would be able to act in the same situation the ones which he considered as his teachers.

November 7, 1947, in the course of the ceremony organized by the F.M.T.S. at the occasion of the tenth anniversary of the death of Lord Rutherford, Joliot made the speech.

> Which would have been the position of Rutherford in front of the problems posed by the existence of the atomic bomb? It is difficult to determine it.
> Nevertheless on February 7, 1916, during World War I, Rutherford in the New Islington Public Hall, replying to engineers who asked him some questions on the liberation of the energy of radium to the utilizable ends said: "A book of this substance of which we will know how to liberate the energy in a suitable rhythm corresponding to the utilization of one hundred millions of books of coal" and he added: "Fortunately at present we have not yet found the method and I hope personally that we discover it only when men will live in peace one with another."

Now the method had been found, during war and for war. It had not only been found, but put in operation to dangerous ends. However, Joliot resisted from despairing and he continued:

> To the anxieties that embrace us must succeed a large and firm hope founded on the objective examination of the marvels acquired by science and the revelations of the benefiting perspectives that it offers us. Thanks to some men of science as Ernest Rutherford, our horizon is lighting up by a destiny more exalting than any of those until now predicted and it is with confidence that the scientist pursues his work...

Joliot participated actively in the elaboration of the constitutive texts of the World Federation of Scientific Workers. Among these documents, it is convenient to mention especially the Charter of Scientific Workers, whose wording was principally due to the great British scientist J.D. Bernal, the one that

Paul Langevin ascribed one day the title of "citizen of the world."

Twelve years of struggle side by side established between Joliot and Bernal a friendship and a deep reciprocal estime. It is Bernal who described one day in the following manner the action of Joliot beside scientists:

> It remained for him another task, more difficult and less known: the one of rallying scientific work in almost its entirety against atomic war. It was no longer a question here of uniting people who could agree on great political policies, but rather to have felt in persons diverse development and interest that the problem of avoiding a nuclear war prevailed over all others.

Joliot wrote, in 1947, for the World Federation of Scientific Workers an "Introduction" in which he explains the reasons for which an action of scientists on the world scale seems to him indispensable.

> There is of that a generation nobody took seriously in doubt that science the manifestation of the highest qualities of the human spirit, was the most fruitful source of material and spiritual benefits. Certainly, the popular diffusion of scientific knowledge always met powerful enemies in the tenets of imperious mystics and those of which the profits and privileges were retained in the fearful ignorance of the beings whom they were dominating. Despite some initial difficulties and injustices due to bad use of scientific progress, the popular confidence in science went unceasingly believing.

But the happenings of the last decades and the appearance of the atomic bomb runs the risk of reversing this course.

> It seems to me that there is a place before bringing a judgment to distinguish pure scientific knowledge from uses which are made of it, in brief, to distinguish in science the thought behind the action.
>
> Pure scientific knowledge brings peace in our minds and a firm confidence in the rising of mankind by driving away superstitions, the terror of unseen powers and giving us a consciousness more and more clear of

> our situation in the universe. It is in addition, and it is one of its highest titles, a basic element of unity between the thoughts of men dispersed on the globe.[1]

After having a time of the more denounced mistakes of "secrecy" in the matter of basic research, he came back on the moral value of science.

> We consider sometimes science in itself as moral or immoral following the applications which are made of it. The discoveries and inventions present for the most part between them a twofold aspect beneficial as well as destructive, it is men who make of it the usage who alone are to judge. It is useless to recall here the most notoious examples of the uses of science, of what can call abductions of science. We cannot deny the difficulties of our time are a major part of it the consequence. But one is also right in thinking that we will be prey and how weak with other difficulties no doubt more tragic yet if science had not progressed. Many scientists think rightly that the abductions of science can be avoided, they do not wish to be accomplices of those that a bad social organization lets exploit the results of their work to egoist and spiteful ends. It is undeniable that a crisis of conscience has seized the scientific world and that the sense of social responsibility of the scientist grows and is defined every day. Scientists and technicians do not take part and connot have a part of an elite detached from practical contingencies. They must necessarily, as member citizens of the great society of workers, busy themselves with the usage that society makes of their discoveries and inventions in order to assure a full utilization of science with regard to peace and the well-being of humanity.

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However, the uneasiness provoked by the extension of the cold war, the knowledge that is beginning to be diffused on the menaces of atomic war is going to provoke a little everywhere the creation of groups, of movements. The initiators or animators of these movements are going to turn themselves also toward the one who

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[1]Text underlined by Joliot.

has already been chosen by the scientists themselves in order to request him of wishing to take their leadership. It is thus that Frederic Joliot-Curie will be led to direct the crusade for peace.

February 24, 1948, thirty persons, workers, intellectuals, for the majority some former "members of the Resistance Movement" were reunited in a living room of the very respectable "Hotel of the Two Worlds," Avenue of the Opera, in Paris. Under the presiding hand of Yves Farge had just been founded the "Combattants for Liberty," which would be changed into "Combattants for Liberty and Peace," then into "Movement for Peace." Joliot was present at this gathering.

In April 1948, the congress organized by the "Committee of Liaison of Intellectuals" is assembled in Wroclaw (Poland). Joliot had not been able to go, but Irene Joliot-Curie was a part of the French delegation at the sides of Mrs. Eugenie Cotton, Pablo Picasso, Abbe Boulier, Vercors...

In December 1948, it is the "International Democratic Federation of Women" whose Bureau is assembled in Budapest and which, like the Committee of Liaison of Intellectuals, hopes to see a large International Congress of Peace to reassemble at the earliest (opportunity).

Mrs. Eugenie Cotton was in charge of going and proposing to Joliot the presidency of this congress:

> He did not give me immediately his final answer; he maintained at first the point of view that the women having been the prominent element in the struggle for liberation during World War II, it would be proper to elect a woman-president and not a man-president. I was very sensitive to this appreciation of Frederic Joliot-Curie on the role of women, but I will not

> insist less of it that he become, himself, the president of the International Congress which was going to be held in the Pleyel Room in April 1949. He gave his concurrence several days after and it was a great opportunity for the Movement for Peace.[1]

A preparatory committe launched on February 25, 1949, the appeal for the convocation of the Congress of Pleyel. This happened in a small, appropriate office, unadorned, located at No. 2, Elysee Street, in Paris, where six persons were assembled about a shelf set on a stage. These six participants must have been at this moment very struck by the importance of their gesture since one among them, Professor J.D. Bernal, would bring to mind on August 19, 1958, in front of an immense crowd which accompanied Joliot to his last resting place.

By accepting the presidency of the congress, Joliot knew that the task was going to be heavy, absorbing, that it would necessitate efforts uninterrupted for many years, efforts that were going to add to those that he has already accepted to furnish for other organizations. He knew finally that he must preserve the relative independence of diverse groups which, if they have the same president, operate on different projects. But he did not believe to be able to hide from his work, and from this moment, was devoted to the action for peace an important part of his activity.

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On April 20, 1949, in the morning, the accesses of Pleyel House, on the suburb street St. Honore, in Paris was the sight of an unaccustomed agitation. On the sidewalk and in the vast hall which gives access to the many adjoining rooms, one can

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[1] La Pensee, No. 87, September-October 1959, p. 66.

hear all languages, sell all the costumes, meet men and women from all continents. But in the diversity of the appearances, a common point: on all the faces, in all the looks one can read the joy, the resolution, the hope. The "Partisans for Peace" are going to hold their first congress.[1]

Let us enter the large room where the commotion prevails which always precedes the opening of these gatherings. Standing, behind a battery of microphones, the writer Jean Laffitte calls the members of the presidium to come and take their place on the rostrum. Several minutes pass. A relative calm is established. In the middle of the long table, Frederic Joliot-Curie rises, pulls from his pocket a bundle of white sheets, adjusts his glasses, orients the microphone suitably...

> I declare in session the World Congress of the Partisans for Peace.[2]

He has then to wait for many moments before being able to continue. Standing, the delegates of seventy-two countries applaud the great scientist. All, whether they came from Europe, from Asia, from Africa, from America, or from miles away, whether they live in a socialist country or in a capitalist country, whether their homeland be powerful or modest, independent or under subjection, they all realized the value of this symbol: the first work of the congress which, in the dawn of the atomic era, is going to undertake to safeguard the peace, is going to

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[1] It is convenient to recall that the same day, in Prague, were assembled again all the delegate to which the visa of entrance into France had been refused.

[2] One will find, on p. 223, the text of the opening report of Frederic Joliot-Curie.

to be presided over by one of the scientists who have the most business for permitting man to liberate the energy enclosed in the center of matter. All are happy, all are proud. Why not say that the French are somewhat the more than the others, because it is in their capital, while speaking their language that one of their fellow-citizens is going, first, to address the world.

Frederic Joliot-Curie can finally proceed. He greets the delegates, mentions especially those "of democratic China, of republican Spain, of democratic Greece, of Viet Nam, of the Indonesian Republic." He retraces the history of the congress, analyzes the situation. When he wishes to explain the particular reasons that scientists have for defending peace, the train of his thought inevitably lead him to refer to his teacher:

> It is useless to recall here all that which civilization owes to scientific research, all the great changes which it has brought about in the conditions of life and in the thought of men. As Paul Langevin loved to say, science allows the material liberation of man, the necessary condition for his spiritual and moral liberation.

And he concluded his report, under the repeated applause of the delegates standing:

> We are making an appeal to all honest people in order to avoid this calamity: war. Together, conscious of our force, we will engage this struggle with the certainty of victory.

The Congress of Pleyel ended with the scheduling of the next meeting in Buffalo Stadium. There still, before the immense and attentive crowd in which young people were visibly in the majority, Frederic Joliot-Curie invited all the popular forces to mobilize themselves in order to save the menaced peace.

Then began for him the long periplus of the capitals.

May 17, 1949, he goes once more to London. Five simultaneous meetings have been organized and the orators are transported from one to the other by a system of automobile rotation as steady as clock-work. All gathered again about midnight in the small living room of the scientific writer J.G. Crowther, the living room that contained difficultly the big voice of Paul Robeson, who with J.D. Bernal, had participated in those gatherings "in clock-work."

Paris in April, London in May, Rome in October 1949.

In the report that he presented in this city at the opening of the session of the Committee of the World Congress of Partisans for Peace, he felt led to discuss one of the reasons which had grown the most on him to join the struggle for peace. Before 1914, as before 1939, courageous men had already grouped themselves in many countries to attempt to stop the march toward war. Joliot sees the reason of thei failure in the fact that the appeal did not have their social position, their citizenship. It had not been possible then--and it is necessary that it be possible now--of convincing all men that the problem of war and peace does not depend any longer on mysterious and inaccessible forces that it is not inscribed in a fatality of the destiny of our species. This problem rises again from people and it is suitable that these take possession of it. It is that he was explaining already in his report to the Congress of Pleyel:

> Each individual of these millions of men who make up the peoples menaced by war must convince themselves that the problem of war and of peace is a problem which is personal to him, which concerns him directly,

> of which it is impossible for him to evade. He must not experience a feeling of weakness because, at the same moment, in all the latitudes, millions of his fellow-creatures are asking themselves the same questions, are going to act for peace and add their efforts to his own.

At Rome, he concluded:

> We have in the last part of April, in Paris, laid the bases for a large reassembling for peace, for an action spread in order to denounce and have deferred the fomenters of war.
>
> . . . . . .
>
> Tomorrow, we will find outselves moreover, always enlivened by the same faith, always determined to attempt all in order that our children do not know the horrors of a new war, in order that science be not criminally out of the way of its object, in order that the efforts accumulated from all the workers of work produce happiness and not ruin. We will continue then so much that the danger will not be turned aside. Nothing will stop us.

This struggle for life, for the defense of peace, is going to receive in March 1950, a decisive impetus at the close of the meeting of the Committee of the World Congress in Stockholm.

In his report Joliot put first all emphasis on the idea of which he wonders today how certain ones have been able, at the time, to style it as revolutionary, as illusive, or as hypocritical, the one of "coexistence."

> There is no longer any United Nations Organization if trust does not prevail. The re-establishment of this seems to me in season, in the present state of relations, between nations, by the necessary conviction that the coexistence of the capitalist states and the socialist states and their cooperation are possible and desirable.
>
> This principle, it seems to us, conforms to the historical truth and in order to admit it that we have only to make the analysis and criticism of it honestly, and not to busy ourselves in the first place with knowing who has formulated it.

Then he approached atomic problems. He was unable to recall the peroration of the conference which he declared in this same city December 12, 1935 (see p. 13).

The bold anticipation then had become the threatening reality of the present:

> I acknowledge that, in my opinion, I was envisaging then a remote expiration due. Less than fifteen years of work have been enough for the scientists to realize this stupendous application.
>
> If i were wanting to do again here, an examination of what has been realized, in less than fifteen years in this domain and of the new possibilities that are opened, I would be led to enumerate magnificent experiments and horrible destructions.
>
> That the admirable series of scientific discoveries embarked upon at the dawn of the twentieth century by Henry Becquerel, Pierre and Marie Curie, had as a result in seeing brandished on the human species the menace of its destruction by the hydrogen bomb constituted a grave warning for all, and for scientists in particular.

And the end of five days of precise discussions, the delegates decided to cast out to the world a formal appeal. The text of this appeal would be submitted individually to all in order that those who approved the terms of it place there their signatures.

March 19, 1950, the day of his fiftieth birthday, Joliot found himself presented a white page on which were typewritten the four paragraphs of the text become historical under the name of the Appeal of Stockholm.

> We demand the absolute veto of the atomic weapon, the weapon of terror and massive extermination of populations.
>
> We demand the establishment of a rigorous international control in order to assure the application of this measure of veto.
>
> We consider that the government which, first of all would utilize, against no matter which country, the atomic weapon, would commit a crime against humanity

> and would be dealt with as a criminal of war.
> We summon all men of good will in the world to sign this appeal.
>
> Stockholm, March 19, 1950.

First, Joliot affixed his signature.

Eight months later, when he presented the opening report to the Second World Congress of Partisans for Peace, in Varsovie, five hundred million signatures had already been received.

> I would wish to say here that one will never sufficiently render tribute to the women and to the men of good will who, in all countries, who went to find individually their fellow-citizens in order to speak to them about these problems, to hear their objections, to answer their questions, to disprove their errors, and to take note of their suggestions.
> . . . . . .
>
> This large international popular consultation has led those who have taken part in it to examine some problems which they did not at times suspect, to reflect on the effectiveness of the proposed measures, to wonder if, although necessary, these measures were sufficient.

It was not at Varsovie, but at Sheffield, in Great Britain, that this Second Congress of Partisans for Peace had been assembled. The major of this great city was agreed, but the British government decided otherwise. Joliot was unable to debark on British soil and, all as a veto of residence, he was repelled. He finished the return trip to France in the messroom of the ship's captain indignant of the treatment which had been reserved to the French scientist. Upon arriving at Dunkerque, the dockworkers, in several minutes, organized a demonstration during which a large bouquet of flowers was delivered to him. An hour later, the main telephone of this port received an appeal in expedience from Prague: they requested Professor

Joliot-Curie "somewhere in Dunkerque." Methodically and with joy, the telephone operators explored all the possibilities, discovered the cafe where the "pilgrims for peace" were refreshing themselves and were able to establish contact between the physicist Joliot-Curie and the write Ilya Ehrenbourg: It was decided to convene the Congress at Varsovie.

In several days, the Polish succeeded in the feat or organizing the reception and the possibilities of reunion for 2,065 delegates, originating from eighty-four countries. At the end of the congress, it was decided to create a new body, the World Council for Peace. Joliot, by acclamation, was named president of it.

Among the hearers of Joliot at Varsovie, was the great Polish physicist Leopold Infeld. It was the occasion of the first of their many meetings.

> "How is present to my memory," write L. Infeld,[1] "the first speech of Frederic Joliot-Curie to the congress! There was not the least trace of the accomodating oratorical effect. His account was serious, objective, yet eloquent and persuasive. During these unforgettable days at the Congress of Varsovie, I had many times the occasion to meet again Professor Joliot-Curie."
>
> . . . . . .
>
> "I was always conscious of the air of grandeur which emanated from this man. His radiation was enhanced even by his modesty, his kindness, and his politeness. I remember that we conversed together on Marxism, speaking of the necessity of interpreting without dogmatism, and of the danger of dogmatism in scientific thought.

After Varsovie, it was Helsinki. After Helsinki, Vienna. After Vienna, Paris. And then Vienna again, Prague, Budapest,etc...

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[1] La Pensee, No. 87, September-October 1959, p. 52.

Now it will be meetings of work in small committee, now of large congresses. In order to prepare for them, it is necessary to establish and to consult a large documentation, to receive calls, to solicit audiences, to write, to discuss, to answer... To all these tasks, Joliot is devoted with the feeling of his reponsibility as president of an immense assemblage fighting in order to conserve that very invaluable thing: peace among men.

In order for all those who have participated at these sessions for peace, the memory of Frederic Joliot-Curie remained associated with all a series of images of which the group constitutes the atmosphere so characteristic of these congresses.

Whatever be the setting of the meeting (hall, stained-glass window, theater, concert room...), certain elements are unchangeable, functionally present: the banner, the flags, the streamers covered with slogans, the headphone batteries for the transmissions in many languages, the long tables on which will come to be stacked the printed texts, the technical services.

Not far from the room of the meetings, is an office on whose door is inscribed the distinction "president." Before and all during the congress Joliot receives many there, day and night. These conversations, following all those that he had in the Antony house or in his office of the College de France, represent little known part, but an extremely important part of his work for peace. A word better than long sentences characterizes it: on a day he came then, between two congress meetings, to converse with Joliot in his office, Yves Farge,

passing one of his friends in the corrider, explained to him: "I am leaving confessional."

In the crowd of delegates which is present in the meeting room and in the corridors, it is not only the languages, the colors of skins, the dressing habits which differ. Each on e arrives at the congress with his particular preoccupations, with his own view of international problems. The emphasis put on such peril, on such an incident, is difference according as one comes from Norway or from Bolivia, from Great Britain or Cameroon, from the Soviet Union or from Ceylon. And it is one of the most arduous tasks of the president that of knowing how to take into consideration of all these factors.

When the congress room is full and the meeting has been declared in session, a relative silence is established, the president of the World Council for Peace, dressed dismally, his features drawn by fatigue, several handclaps, makes his way toward the lectern and the microphones.

On the platform, the members of the presidium, in the room all the participants rise and, while the applauding cracks, hundreds of pairs of eyes turn toward this man of medium height and who, far off, appears rather thin. All the gazes express emotion and gratitude.

As for Frederic Joliot-Curie, he feels always at this very moment, an emotion that renewal will never come to render less alive. His extraordinary sensitivity allows him to establish close contact with each one of those who have come there, sometimes from miles away. His weariness disappears and it is with a clear voice that assails the first sentences of his report.

One by one he reads his papers, sometimes he ceased to follow his notes, adds comments, speaks extemporaneously. He stops to freshen himself with a sip of water, resumes with a tone roused or alive, sometimes even violent. But always is reflected in what he expresses the qualities of a scientist: the precision of the terms, the rigor of the analysis.

Several days before, Frederic Joliot-Curie wearing his apartment jacket with black and white checks, was seated behind his desk, in his house at Antony. Looking to his right, through the glass door, he could perceive with an envious glance the tennis court where his son, Pierre is disputing a match with Irene or a friend. Behind him, a large panel covered with photographs artistically arranged in disorder: his wife, his children, Langevin, Lenin, a congress room, his co-workers close by the pile at Chatillon, the panorama of the demonstration of Oradour-sur-Glane, a cliche taken with the Wilson chamber.

In front of him, several pages covered with notes. But he perceives well that these leafs (of paper), only several minutes ago, to replace the Physics Review still open and pushed aside to his left all against his calculated regularity and an ash tray of which the workmanship is eloquent.

In a basket, to his left, some magazines, brochures, pamphlets, in another basket with mail, a third with English, Russian (et al.) scientific periodicals. Opposite him one or two close co-workers have taken their places, white paper and pen in hand. In the dining room, behind him, a secretary is waiting, or is already recopying some text.

--I have laid the foundations of the principal points of my report. Here...

And the discussion is undertaken. He wants at any cost that no points remain obscure. He maintains to that which all references be verified. He invites his interpreters to become "the lawyer of the devil."

Irene comes and announces that the meal is served. She is very badly received. "You have the nerve to interrupt a discussion at the moment when all was going to be enlightened!" She disappears... but she will come back obstinately every ten minutes, so although he will finish, with a smile, but admitting himself conquered. Thus during two or three days. And, at each time, will come the time when he will interrupt the work in order to exclaim: "But, after all, why is it necessary that it be me that presents this report in Rome or this speech in Helsinki! My profession is being a physicist, of working with my hands in the laboratory: I have two theses to correct, this article to read, my course of the College to prepare..." At this moment, no doubt, come back to him in memory this short dialogue between Irene and their young son Pierre, on the day that he was leaving to participate in an electoral meeting:

> --It is not his profession, bojected Pierre, of going and speaking in this schoolyeard.
> --Perhaps because it is not his profession, retorted Irene, he no longer has any chance of becoming heard, of catching the hearer.[1]

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[1]On December 13, 1960, Laurent Casanova, bringing to mind the demonstration of Buffalo in April 1940 said: "Joliot-Curie, Picasso, Aragon! Fortunate circumstances had allowed this meeting. The echo was profound of it in the masses, because there was something unusual to see advanced then, at the head of popular

Then Joliot will take a new cigarette and, staring at his questioner beyond the flame of his match, he answers himself aloud: "If I wish, tomorrow, to be able to do research, if I wish that the young people can devote themselves without second thought and in the best terms, it is very necessary to build a society which will recognize the role of science, a society in which war would be not only impossible, but unthinkable. Langevin also told me often that he would have preferred to be able to do only that of a physicist. Let us resume out work."

The following day, the first version already typewritten, is a magazine, torn to pieces. Then the edifice is constructed, the conclusion asserts itself. The second day after or several days later, to hundreds of kilometers from there, Frederic Joliot-Curie ends his report before the "World Council for Peace." A new stone is placed on the wall which will erect the obstacle in front of menacing war.

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Only five years after the first atomic bomb a new device, a thousand times more powerful is experimented with success: the hydrogen bomb. The United States, the Soviet Union, Great Britain produce, stock, test these new weapons of mass destruction, even though negotiations involved at the United Nations Organization are unsuccessful in getting out of the rut.

From 1950 to his death in 1958, it is not exaggerated to say that the action against the nuclear perils constituted the dominating preoccupation of Frederic Joliot-Curie.

The declaration that he published January 13, 1955, ends by the following paragraph:

> The problem which is posed, it is not to know to which echelon of Major State or of minister or of meeting of ministers, with or without veto, one will be able to decide about atomic war. The problem is knowing if humanity will accept the ruins, the destructions, the death of hundreds of millions of beings, the misery for the survivors, the probable creation in this case of monsters and even the possibility of the abolition of all life on the planet.

He is concerned also about offering an issue to those who do not choose to wait, terrified, that the cataclysmic exterminator is produced.

> It is necessary to inform the most accurately possible public opinion that of the extent of the dangers and to propose at the same time of the solutions which permit adorning the perils. In the greatest danger, one cannot have panic when each one is acquainted with the course that it is suitable for him to follow, in order to avoid the catastrophe. The course exists, we will never be allowed to repeat it, it exists necessarily since we are in the presence of immense forces, indeed, but liberated by man and of which the latter has perfectly power to direct the utilization, exclusively toward peaceful ends. The situation would be all the other if we had a matter with a brutal menace of natural forces as the one that would constitute the announcement of a next collision with our planet, with an immense meteorite.[1]

The peril for humanity is double, and Joliot will never cease struggling on these two fronts:

First of all accumulation alone of atomic bombs and of hydrogen bombs menaces the peace and he denounces the fallacious thesis according to which the horror of a new war would suffice to render this war impossible.

> The monstrous nature of modern weapons is especially referred to frequently in a false and dangerous reasoning:

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action, three men for which politics, in the usual meaning of the term, was not there first interest in life."

[1]National Council of the French Movement for Peace, Drancy, April 8, 1955.

> the nuclear war would be so horrible that no one will ever dare unleash it and peace will be maintained by "the equilibrum of terror." The over-simple allure of this reasoning has given to him an audience who would risk, if we were not on guard, leading very simply to the catastrophe.[1]

Finally, the research carried out for the perfecting of these nuclear and thermonuclear weapons makes necessary a series of experimental explosions. The latter spread in the atmosphere radioactive products of which the effects risk being very harmful not only for the beings presently living, but for their descendants.

The protest movement began in the offices of scientists, then was broadened to the entire world. March 1, 1954, marked in a tragic way an important date in this struggle of public opinion against the pursuit of the experiment explosions of nuclear weapons when the experimentation at Bikini of a hydrogen bomb had several victims, of which one death, among the crew of a Japanese fishing boat which was one hundred twenty kilometers from the site of the explosion.

April 16, 1957, Joliot declared in front of the microphone and the medium of French Radiotelevision, the first of two lectures which have been requested of him on "The great discoveries of radioactivity."

The second lecture would have been delivered on April 23, 1957. It was forbidden by the government (who) feared the following paragraphs devoted to the dangers of experimental explosions of nuclear weapons.[2]

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[1]Speech of F. Joliot-Curie to the "International Congress for Disarmament and International Cooperation" (Stockholm, July 16, 1958).

[2]The whole text was published in La Nef of May 1957.

> If it is necessary to come to an agreement eliminating atomic weapons,--and it is the destiny of entire humanity which is involved,--it is necessary, from now on, to have experimental explosions stopped.
>
> Grave warnings have been many times repeated by competent scientists since the first experimental explosions of nuclear weapons.
>
> . . . . . .
>
> Even in time of peace, the danger exists. If we do not stop the continuations of experimental explosions, the percentage of radio-strontium will exceed certainly the amount to which men can be exposed, and especially young children in full growth, (radioactive) values sufficient to provoke numerous cases of cancer, of bone disease and leukemia.
>
> . . . . . .
>
> Believe me! a great danger bears on each one of us and on our descendants if we do not, from now on, suspend the experimental explosion of nuclear weapons.

A year later, a first favorable decision was finally made by the Soviet Union. Joliot emphasized the importance of it in the conclusion of an article devoted to "The World Crusade Against the Atomic Peril," (which) appeared in Scientific World.[1]

> The decision taken on March 31, 1958, by the Soviet government to stop unilaterally the tests of nuclear weapons has aroused in the world the hope that this gesture would soon be followed by the governments of the United States and Great Britain. Public opinion follows with attention the negotiations which are continuing with regard to an agreement on this question between the three powerful holders of nuclear weapons. Its wish does not leave any doubt for a person. It is alerted, it has followed conscience on the menace which is weighing on humanity and it wishes that they finish with the tests of nuclear weapons.

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The destructive power of the atomic bomb and the hydrogen bomb, the immediate and deferred effects of radioactive fall-out

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[1] Vol. II, No. 2, p. 38.

due to experimental explosions have been described in detail by a large number of scientists having authority. And yet, so much in the opinion that close to responsible authorities, there exists a certain scepticism. One of the sources of this state of mind can be found in the fact that the authors of the warnings could appear not only as scientific, but also appearing in a traditional political or philosophical family. On the other hand, there exists still some points on which the agreement is not realized between the specialists as for the breadth of such and such consequence of atomic explosions. And well that none of these specialists thinks for an instant to deny the terrible menace, these differences of opinions provoke, without justifying it, a tendency to wish to diminish or ignore the perils.

Also, since 1950, Joliot wanted to assemble around a table scientists of all countries and of all political or philosophical opinions. On some exact scientific problems it would be possible to lead to a common valuation. The effect would be great on public opinion which would then be in proportion as exisiting everywhere that the governments suggest or accept the decisions capable of preserving the future of men.

The task revealed itself very difficult because the climate of the cold war and of "the hunting of sorcerers" made many Western scientists hesitate to meet with Soviet colleagues or even with their fellow-countrymen, classified as "rogues." But Joliot did not let himself act in this way at all.

A decisive turning in these difficult negotiations was produced when, having taken knowledge of a speech aired by radio

of the British philosopher Bertrand Russell ascended favorably to the ideal of a joint declaration of scientists "to the condition that the interested parties have not the same political convictions and that their declaration be exempt from all blame on the past faults or that which could be considered as such."[1] By contrast, he was stating precisely some doubts as to the necessity or to the possibility of convoking, at an opportune time, an international scientific conference. In April 1955, having finally accepted the idea of such a conference, Bertrand Russell, appealed to several colleagues, of whom Einstein, and submitted to them a plan of declaration.

When on April 20, 1955, Bertrand Russell came to Paris, he had with Joliot a long conversation on the issue of which the respective positions of the two interlocuters were considerably brought into harmony. Moreover, from the first, Bertrand Russell stated precisely his general position in telling Joliot that which the latter told again for his close friends in the following way: "I am anti-communist, and it is precisely because you are communist that I am considering collaborating with you."

The exchanges of correspondence continued still, marked principally by the letter of Joliot to Bertrand Russell date May 13, 1955, and the reply of the latter on June 17 (one will find these texts on pp. 230-238).[2] Finally, the text of the

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[1]"The signatories should have no common political complexion and that their declaration should strenuously abstain from any blame to either side for past mistakes or what were thought such."

[2]These letters are published with the permission of Lord Russell, to which I am expressing most ardent thanks.

appeal having been approved by Einstein during the last week of the life of this great man, it was made public by Bertrand Russell, Saturday, July 9, 1955, in the course of a press conference at Paxton Hall in London.

Joliot had given his agreement to this text universally known under the name of the Einstein-Russell Appeal in pairing of two important cautions: the first aimed at the relinquishment of supremacy "which would be accepted by all and in the interest of all." The second caution endorsed the model "humanity must renounce war;" Joliot requested the addition of the words "in as much as the means of adjusting the disputes between states" in a way not condemning the movement which, within a nation, can be led to fight injustices, nor by wars by which the subjected peoples acquired their independence.

When Joliot contends with such a passion for the prohibition of atomic weapons and for the cessation of experimental explosions of these weapons, he does not yield to the anxiety of preservation of the human species. He devoted his life to science, he contributed to its progress, he has drawn from it the most profound and the purest joys. These joys, he was describing before a Portuguese journalist who was questioning him on the discovery of artificial radioactivity:[1]

> It was for me a childish joy: I began to run and to jump in the vast basement, deserted at that hour. I was thinking of the consequences which could spring from this discovery.

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[1]Newspaper Republica of January 10, 1955.

But these joys would become impossible if society permitted that science be utilized for destruction. It has been rather difficult all along in history of having the scientific mind prevail over the doctrinal blackout for all to perform in order that men, badly informed, not have dropped again on science itself the judgment that the perversions of the latter merit.

It is this twofold worry of preserving humanity and of safeguarding the influence of science which causes him to rise up against the utilization of biological weapons. March 8, 1952, Joliot launches an appeal demanding the stoppage of the first endeavors of bacteriological warfare in Korea and respect for the protocol of Geneva of June 17, 1925.

May 3, 1952, he replies, in impassioned terms, to a letter from a delegate of the United States to the United Nations, Mr. Warren R. Austin:

> Before ending, I would like to tell you that I have been shocked by the tone intended insulting of your letter. You are accusing me of prostituting science because I rise against the criminal use of the discoveries of the great Pasteur and because I am making an appeal to public opinion to prevent the continuation of bacteriological war.
>
> For me, those who prostitute science are those who have managed to begin the atomic era by anihilating two hundred million civilians at Hiroshima and at Nagasaki.
>
> . . . . . .
>
> It is because I know all that which science can bring to the world that I will continue my efforts in order that it serve the welfare of men, whether they be white, black, or yellow, and not their anihilating, in the name of I do not know which divine mission.

Then, on October 24, 1952, conveying and commenting upon the conclusions of the International Scientific Commission of Inquiry, he writes to the presidents of the associations

affiliated with the World Federation of Scientific Workers:

. . . . . .

> It is due the task of the scientific workers of informing their fellow-citizens, by the most appropriate means of the dangers that have run after humanity the biological weapons and of making known the international agreements subscribed to this utterance.
>
> . . . . . .
>
> It is well our task as scientists to oppose ourselves to this true diversions of science, which risk obscuring in a great number of minds the true function of the latter.

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In order that science serve fully to the welfare of men, it would be necessary that the social system permit it full bloom and the utilization to the benefit of all. For this reason, Joliot is a communist. But even in the present condition of the civilized world, it would be necessary that cease the absolutely unheard-of squandering of wealth that makes up the production of weapons. With perhaps as much earnestness as for the prohibition of atomic weapons, Joliot will devote his efforts to the struggle for disarmament. In this respect, his last speech to the Movement for Peace--a speech that he was unable to read himself--can be considered as a will in which he discussed at length his two basic preoccupations.

As he had done at the Congress of Pleyel or at the Assembly of Rome, he studies first of all the failures of the attempts of disarmament which had preceded World War I.

> We cannot forget that the history of this first half of the twentieth century involves, for that which concerns disarmament, many actions, many hopes, many promises, but also how many deceptions: for talking only of the years which followed World War I, do we remember that "Kellogg-Briand" Pact, signed on August 27, 1928, by nine powers of which the United States, France,

> Great Britain, Japan, Germany, and Italy. Other countries, among them the Soviet Union, were finally invited and participated. The contracting parties were condemning the recourse to war for the adjustment of international disputes and were pledging themselves only to use to this effect peaceful means.
>
> These pledges matched with declarations and with formal ceremonies agreed, it is not doubtful, with the will of the people. But the best declarations have value only if they are sanctioned by concrete acts. In this case, the unquestionable concrete act would have been an agreement of disarmament.

In 1929, direct military expenditures were consuming 4.2 billion dollars. In 1957, they reach one hundred billion dollars (sixty for the countries of N.A.T.O., thirty for the socialist countries, more than six for the underdeveloped countries).

Certainly the "profits" realized in this production plays in favor of its maintenance and Joliot emphasizes it:

> We are not losing sight of that the development of weapons constitutes for certain people what they call "a good business." The weapons especially of our time when they are rapidly out of date, guarantee sure orders, with hazards, without the risks of competition. In addition, the necessary investments--often considerable--are financed by taxes, and it is thus that those who are, in the large majority, opposed to the course of armaments, see themselves taking out a fraction of their incomes in order to maintain it.

Joliot analyzes finally the fear experience by many by seeing set up the unemployment and the crisis if a significant fraction of the hundred millions of men directly or indirectly under the weapons (manufacture) came to be rendered available (for employment):

> We know that with only a part of the astronomical expenditures devoted to armaments, we could assure work to all these workers, technicians, engineers, in order to produce goods for consumption.
>
> . . . . . .
>
> Schools, housing, bridges, roads, dams, is there not there of which to bring about the necessary reconversion of factories which, for war waste so many human efforts.

It is necessary therefore, not only to make know the danger of war that the course to armaments possesses, it is necessary not only to have perceived fully all the wealth that the abandonment of this course would permit releasing, but it is necessary to remove the fears that have until the present prevented the popular pressure from being sufficient in order to overcome interested opposition.

. . . . . .

> "The sincere acceptance of peaceful coexistence leads to disarmament, but the latter is possible only if we quell the reasons invoked in order to attempt to justify the course to armaments. It is necessary, for that, not to approach isolatedly the questions of disarmament, but to connect it intimately to the questions of international cooperation and expansion. It seems to be notably necessary to examine the question of disarmament in relation with the economic questions. It is necessary to bring in detail, and with precision, the proof that the cessation of the cold war and of the course to armaments will lead to the raising of the level of life of the nations," whatever be their economic and social system, and I insist on this point.

Likewise that Joliot has always challenged those who invoke the future life in order to have acknowledged and upheld social injustices, he had insisted on many occasions on the fact that the scientific discoveries allow <u>from now on</u> to lighten the task of men, to eliminate the misery and that only the desire to maintain the privileges have reserved of it the benefit of a minority.

He returned there in his last discourse at Stockholm, convinced that it was that if men <u>knew</u> that these benefits <u>are</u> at their disposal, they would not fail to insist on what is due them:

> It is not a question there of an idyllic picture beyond realities, or of a dream for a distant future. It does not depend on our making of it the reality of tomorrow.

VII

THE END OF A LIFE TURNED TOWARD THE FUTURE

July 14, 1951, Irene and Frederic Joliot-Curie are celebrating the National Holiday in the course of a private dinner in the company of Mrs. Eugenie Cotton. The table was decorated with three colors and after the meal, Irene, very gay, improvised some songs on themes inspired from Breton folklore.

This scene was not occurring at the place of l'Arcouest, but at forty kilometers from Moscow and, not far from the three Frenchmen, A. Vychinsky was unendingly holding in check.

The stay in this house of rest had been very pleasant and Joliot--he told it frequently afterward--had had to master only one grave difficulty: to obtained broiled steak "French style" instead and in place of meat, certainly of good quality, but infinitely overdone!

Several days before, on July 4, in a room of the Kremlin, the academician Dimitri Skobeltzyne had handed over to Joliot the first of the international prizes for peace. In his reply, Joliot would say particularly:

> For all the honest people in the world, whether it be in the capitalist countries or the many in the socialist countries, the creation of international prizes for peace constitutes a concrete proof of the fervent wish for peace of the government and of the Soviet people who make only one.

Among the first nine receivers of these prizes figured likewise Mrs. Eugenie Cotton and the joy that the latter experienced in receiving this high distinction at the same time that

Joliot did that the one of the latter of finding herself in the company of this great woman toward whom he felt as much respect as affection.

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* *

Less than two years later, Joliot would undego the first attack of illness. In May 1953, he was going to Strassburg, in the company of Rene Lucas, in order to participate in the meetings of the Adminstration Council of the Institute of Nuclear Physics. He would be hospitalized, could resume his work, but the disease would recur in 1955 and he would undergo a long treatment at St. Antoine Hospital in Paris. He divided his compelled leisure between mathematics (as at the time of the operation for appendicitus which he had undergone in 1926), the drawing black pencil and with colored pencils. He had long conversations with Dr. Jacques Caroli who was directing the section and a solidly based friendship on a reciprocal esteem was developed rapidly between them. Leaving the hospital, he delivered to Dr. Caroli not only a pencil drawing, but likewise a memoire in which he suggested the improvement of certain methods of observation and measures utilized in the treatment which he had just undergone with success.

It is at this time likewise that he was caught up with a new interest for painting. At Antony, in Auvergne and in Brittany, he executed several paintings representing the countryside which was dear to him.

Although his health improved slowly, but continuously, he was constrained, otherwise to reduce his activity, but to limit his traveling. He stayed much at Antony, received many visits,

was summoning there in succession the workers of his laboratory. But neither reading, nor the conversations could be sufficient for him. It was neglecting for him manual labor.

In order to satisfy this genuine need, he had installed in his house a small laboratory, a blackroom for photography and particularly a small mechanical workshop with a turn and a drill. Thus it is that he carried out at his home emperiments relating to a superassessment that had been requested of him in the famous case of poisoning as well as some investigations on the amounts compared in strontium from fresh evaporated milk and from old milk with a view to examining the consequences of radioactive fall-out due to the experimental explosions of nuclear weapons.

His strength cam back to him progressively. He could, as every year before, go skiing in the winter at Courchevel and fishing in the summer at l'Arcouest. However the idea of his death preoccupied him much and he told me often his conviction of not having a long time to live. Despite appearances, he felt himself branded with the illness and he was convinced of dying well before Irene. He directed these words to me with much objectivity, and it is difficult for me, at a distance, to have part of the need of being entrusted and of the hope of receiving a comforting flat contradiction.

March 17, 1956, swept away by leukemia, unquestionably resulting from the long years spent working in the presence of the radiation of radioactive substances and in the months spent in the radiological branch in the armies, during World War I, Irene Joliot-Curie died.

Joliot had recognized the source of the illness of Irene, but he contended that the hepatic ailment that he suffered was a consequence of his exposure to radiation. He emphasized, when the discussion bore on this point, the great care that he had always taken to protect himself and the insistence that he put close to his co-workers in order to compel the latter to do the same. Only the imprudent ones of the too premature experimenters or, in industry, the criminal saving done too often on security, renders this work dangerous and he rose up violently against the erroneous conclusions that they could draw from his illness in order to discourage the researchers from assuming the path that he had chosen.

The death of his wife carried a very hard blow for him, once again, to question himself on the meaning of the work that he had accomplished with Irene. It is then that he wrote the study on The Human Value of Science, the text in which one can best perceive all his personality.[1]

> The consciousness of influence, great or small--but certain--on the generations to come, that our passage on this earth gives to each of us, led me, from my adolescence, to envisage in a manner more calm my anxiety before death. Every man has a reflex of denial at the thought of a nothingness which would follow death. The idea of nothing is so unbearable that men have wished to fall back on the belief of a survival in another world ruled by one of the gods.
>
> A rationalist by nature, I denied myself, very young, this belief without foundation and fragile.
>
> Some terrible deceptions I was the witness at the time of those which, suddenly, lost the faith! But... --I was going to say: But the devil!--why to have imagined a survival in another world! My concern before death amounted to, in my being, very early, to a problem purely human and earthly. Is not eternity in the

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[1]This study published in La Nef of January 1957, is reproduced on pp. 189-199.

> living and perceptible chain, which joins down to us the things and the beings which were made and lived on this earth?
>
> I will invoke, if you permit me, a personal memory. In adolescence, I was writing up one evening an assignment. While working, I was passing my hand over the form of a bourgeois of tin, a souvenir of a very old family. I stopped myself brusquely from writing having experienced a keen emotion. I reconstructed in front of my closed eyes scenes of which this old burger had been no doubt the witness... descent into the cellar to look for the wine for a cheerful anniversary; the sadness sitting up with the dead... I had the impression of entering in contact with his hand which, in the course of the centuries had sustained this burger, I discerned some faces. I felt a great relief by conjuring up thus some vanished beings of which I had just felt myself tightly bound up. Pure imagination, certainly, but the object made me conjure up some unknown missing ones that I was seeing alive, and the fear of nothingness was finally chased from my thoughts.
>
> Every being who passes away on the earth leaves an indelible trace, would it be only a little wood used by the hand on the flight of stairs, only a small stone lifted to the step of the stairs. I like the polished wood bu the usage, the step hollowed by the sten of men; I like my old burger of tin... They carry eternity in them.

Starting with the death of Irene and even in the periods in which his state of health seemed to have again become thriving, Joliot gave to all those who were working at his side, the impression of contending a course against time, against destiny. He wished at all costs to succeed in finishing the group of laboratories of Orsay.

In order to supplant the premises (which had) become very scanty of the Institute of Radium, Irene Joliot-Curie had proposed the construction a new ensemble at the Faculte des Sciences of Paris. Thanks to the very active support of Dean A. Chatelet, the construction of a first series of buildings was decided upon in July 1955.

> The natural setting, in full foliage, where calmness reigns is favorable to basic research. Nevertheless, the clay soil necessitated a very close staking of the terrain which, by situation, would support very heavy loads as those of the accelerators and shelters in concrete against the dangers of radiation. About six months was necessary in order that the buildings begin scarcely to emerge from the ground. Irene Joliot-Curie, who had given so much of her efforts for the realization of this work, was unable, alas! to have the joy to be a witness of that birth.[1]

He dreaded first of all accepting the additional task that succession of his wife represented, but he finally decided to place his candidacy and he was led, from September 1956, to cumulate the functions of professor at the Faculte des Sciences and professor at the College de France (one must date back to Claud Bernard to find a precedent). He resumed with the same liveliness the construction work of which he had already had the experience, presiding at gatherings of architects, visiting the foundry-yeards, summoning the contractors, all this in more of the discussions with researchers, of the walks near the ministries, and of his political and social work.

In August 1957, construction of the first series of buildings was finished and, although the interior equiping was not concluded. Joliot made, in September, the decision of the moving of the workers to Orsay. In his haste, he even cut short his summer vacation in Brittany to return... several days too soon, because his office was not ready to receive him!

Less than a year later, when he described in detail this group of laboratories to the thirteen winners of the Nobel Prize

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[1]"The New Center of Orsay." Lecture of Frederic Joliot-Curie at the meeting of the Nobel Prize at Lindau (June 30-July 3, 1958).

gathered with him at Lindau, on the shore of the Lake of Constance, Joliot will be able to say, not without some pride:

> Presently in our group at Orsay and Paris, around two hundred fifty persons are working, of whom ninety qualified researchers and one hundred fifty technicians, that which represents large effective forces for a laboratory of basic research.

Before going to Lindau, Joliot, whose state of health was improving, had been able to resume his traveling in foreign countries. He had gone in April 1957 to the meeting of the Bureau of the World Council of Peace in Berlin,[1] and in May 1958 to Moscow. In addition to the conversation that he had then with President Khruschev, he visited many laboratories, the one of Doubna, in particular, where he experience a great joy to again find Bruno Pontecorvo. Once more, being with someone who recalls to him certain laboratory scenes before the war, he confides his dream that he hopes to see be realized:

> In one year I will be discharged of my administrative task and I will be able again to do some experiments with my hands.

He had likewise long discussions with his colleagues whom he liked and esteemed very much, such as Professors Blokhintsev, Kourchatov, Skobeltzyne, and also Infeld. He was welcomed at the Soviet Movement of Peace and was able to spend an evening at the residence of his friend, Ilya Ehrenbourg. On his return, in the Tupelov airplane which was bringing him back to France, he communicated his impressions to his friend Roger Mayer. After having indicated how much he had been impressed by what

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[1]For the first time for several years, he accomplished, alone, this traveling.

he had been able to see, by the apparatus and especially by the young generation of scientists, he concluded:

> However, I do not have any reason for not being proud of Orsay and I would not change my team for any other.

One finds again here confidence in his country, the pride of the contribution of France to civilization, the willingness to do so that the future be in the measure of the past. The wealth of France in the scientific domain, Joliot fears that the young people and the public powers be not sufficiently penetrated with it. It is why, answering on December 14, 1954, a questionnaire instituted by the director's office of Higher Education, he had written, on the subject of the sending of scientific missions abroad:

> Then, if one wishes to derive a true education of such a mission, it is necessary to send men who have already brought tangible results to their country and who have an extended knowledge of the material means and of the men living in France. One will thus avoid complexes of inferiority peculiar to those who ignore too much of their country and who report sometimes about the foreigner information that the French have already exported.

He comes back on the importance of scientific traditions, in his speech at Lindau:

> We will try to preserve the traditions so precious of our teachers of radioactivity. It is hazardous to improvise in radioactivity, the domain which risks seeming easy and seeming obsolete to the uninformed nuclear physicists.
>
> The researchers who frequent the laboratories of old traditions often profit without their knowledge from what I call hidden wealth. The ideas expressed formerly in the laboratories by the teachers and the workers in the conversations and penetrate consciously or unconsciously in the thought of younger researchers. In the course of a piece of work, these acquisitions facilitate the correct interpretation and sometimes the discovery. One well understands why such a discovery had more chances of being made in such a laboratory.

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* *

When, on June 29, 1959, in London, the British scientist C.F. Powell was examining the scientific work of Joliot, he declared notably:

> In a sense, Joliot and others were the pioneers of a new route of scientific development, a route which led academic experience to be fused with industrial experience. In a sense, it was the beginning of a great development which transformed experimentation in the domain of science. In the following twenty-five years, the scale of experimentation always became greater and research acquired more and more the characteristics of a large industrial enterprise.

This transformation of the character of research in physics has been one of the last profound preoccupations of Joliot. Taking a look over the thirty years of his life of laboratory work and considering the almost "monstrous" installations which physicists need, he posed, in conclusion of his report at Lindau, the problem of adaptation of the personality to this new framework.

All this text, reproduced (on) p. 187, is to study and to meditate. It is in some sort a last appeal of the great scientist, fondly in love with his profession, to all his colleagues for the study of a new and grave problem posed by scientific progress itself.[1]

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Those who have escaped by miracle in a fatal accident recall frequently having seen march past in an instant the most significant images of all their life.

In the course of his last weeks, Frederic Joliot will have

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[1] See on this subject the colloquy organized by the Frederic and Irene Joliot-Curie Association and published in the magazine Sciences of December 1960.

lived some episodes of life covering the range so rich of his major preoccupations, of activities which brought him the most joy.

On his return from the U.S.S.R., Joliot had, for the last time, participated in a public demonstration organized at the Sorbonne in order to protest against the coup de force of May 13, 1958.

He had, at the Henry Poincare Institute, a reunion with some colleagues of the University and he had triumph, not without difficulties, his conception of education in the course of creation of the Commissioner's Office in Atomic Energy.

After having put the last handwriting to the speech that he had drawn up for the International Congress for Disarmament and International Cooperation (Stockholm July 16-21, 1958), after having inaugurated and presided over the International Congress of Nuclear Physics in Paris, he left by car for l'Arcouest. Previously (at his) last contact with the World Federation of Scientific Workers, he had received, in his office which was the one of Marie Curie, then of Andre Debierne, then of Irene, before being his, his Bulgarian friend Professor Kyril Bratanov, accompanied by Dr. Boyadjieff. They had talked about the beginning of F.M.T.S. (World Federation of Scientific Workers), of car failure unexpectedly happened at night in the course of a trip in Czechoslovakia in 1948, of a bearhunt project in Bulgaria for the summer of 1959.

The last Saturday of July 1958, Roger Mayer, back from Stockholm, has car failure at Dinant, Joliot comes to look for

him with his car and questions him subsequently about the congress. Nearly as much as of the achievement and unmooring of Orsay, Joliot had all these last months been busy seeing well established the necessary connection between economic problems and those of disarmament and peace.

> The children have left on a cruise, he explains to Roger Mayer, we will take the boat, we will be undisturbed, and we will be able to write something more worked out on these questions.

On Sunday evening, after having worked with his seaman to collect the nets, he goes to the home of his friends the Segals. Seated on the ground in front of the children whereas the other great personages were sharing the seats, he listens with rapture to Francis Lemarque play the guitar and sing some songs (while nevertheless expressing his apprehension that the presence of "tots" limit the scope of the repertoire!)

On Monday, he leaves for fishing at four o'clock in the morning. On return, he receives the visit of the superintendent of boats who inspects the log and the compliment--to his great satisfaction--of having maintained his medicine chest on board in perfect order.

It is during the night from Tuesday to Wednesday that a hemorrhage takes him by surprise and causes him to exclaim: "I am lost."

At nine o'clock in the morning, restored but distressed, he leaves his house of l'Arcouest. Lain on the stretcher, he is contemplating the bay, the steep rocks, he is perceiving the sailor with whom he had made a rendezvous for well before dawn.

He does not say anything, but those who are at his sides, who know him and who love him, are reading in his facial expression the adieu to the trees which he had planted, to the terrace that he had consolidated and enlarged, to this corner of the world that he preferred to all the others. All along the route which conducted him, by ambulance, to Saint Brieuc, lain down in a sense opposed to the walk, he comments with several words upon the familiar scenery which unwinds before his companions and himself.

Upon the arrival at Montparnesse Station, an ambulance had been anticipated and some proceedings were undertaken in order that it be able to come inside to the area along the tracks, beside the compartment...The regulations were opposed to it. The negotiations were going to fail at the moment when the engineer of the train, without anything having been requested of him, declared that "with all means he would refuse to maneuver his train so much as a degree that the ambulance of Professor Joliot should not have come to look for it."

At Saint Antoine Hospital where he is regaining his strength, he devotes several hours to writing the last pages of his radioactivity course destined to be published for his students. He corrects the proof-sheets of an article to appear in The Nuclear Age. He was preparing, the physical and the moral returns at the highest, to set out again for Brittany on August 12, 1958.

On August 14, 1958, died the one who, "by his work in nuclear physics had gained his place among the greatest scientists

of the world, and who by his work for mankind had been obtained a place in history."[1]

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[1]C.F. Powell, Address in London, June 22, 1959.

VIII

Joliot Rationalist and Communist

Receiving on June 6, 1950, Roger Mayer who was going to be his secretary and rapidly became his friend, Joliot managed to state precisely from the first: "I am not an intellectual because I like too much to work with my hands. On the other hand it is a word that I never wish to hear uttered in front of me: the one of philosophy."

As Jean Orcel has accurately said, "this irony appeals more to the followers of metaphysical thought than to the philosophical reflection itself, based on the system of the sciences and the general conclusions which are derived from it compulsorily." Moreover, in 1931, we had, Joliot and I, published a study on the "philosophy of Henry Poincare,"[1] a study which begins in the following way:

> Henry Poincare, passionately taken with science, was hearing limited the latter activity of thought and had no faith in all theory not resting near or far from the study of nature. He already had very young this state of mind and Mr. Raymond Poincare, in the course of a conversation that he has wished well to grant to us, has related to us that at the time when he was a student of letters, his cousin was not treating to him tactfully the whims on the usefulness of his metaphysical studies. Science has thus been for Henry Poincare the only law of action, and not content to augment his inheritance as a mathematician and physicist of talen, he has wanted to examine himself in philosophy.

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[1] F. Joliot and P. Biquard, Anthology of the Contemporary French Philosophers, pp. 50-76 (Kra, editor).

Frederic Joliot was profoundly a rationalist. He demonstrated it in numerous articles and lectures and by succeeding Paul Langevin in the presidency of the Rationalist Union.

One day in May 1953, presiding over a lecture given by Paul Langevin and Evry Schatzmann at the occasion of the four hundred tenth anniversary of the death of Copernicus, he said:[1]

> The work of Nicolas Copernicus, scholar with universal talent, great humanist and patriot, incoporates a revolutionary act of a very great consequence. To make the sun the center of the planetary system would run foul of all science inherited from antiquity and the Holy Scriptures. It was a heresy to declare that the earth was not the center of the universe. The Church was not willing to admit it. It was a fruitful work of liberation of the human mind then stewed in a closed vessel, obscured for more than twenty centuries by superstitions and dogmas. But these superstitions and these dogmas were propogated and maintained inflexible by those, moreover little numerous, who found there the source of their gains and the bases of their power. In this great movement of liberation which formed the Renaissance, Copernicus has struck a rude blow at the obscurantist authorities and he has shaken the foundations of a power which, for milleniums, bound society in chains.

This rationalist attitude would lead him progressively to be inclined to the problems of society and to prolong, by enriching it, the rationalism of Descartes and the materialism of the Encyclopedists.

> Our modern rationalism is not a simple adornment of the past. It resolutely makes use of Marxism, of the doctrine discovered by Marx and Engels, to a time when the working class was taking such a place in society that it posed enough questions in order to have need of a specific ideology.

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[1] Text published in the French Letters of June 4, 1953.

Do you see, Frederic Joliot frequently said to me, "one would be able to pardon me no matter which fault, no matter which offense, but not being a communist. Born in a bourgeois family, having received a good education, have obtained some success, being more than at the shelter of need, I have in 'their' eyes not any excuse and the ostracism of which I am the object, has absolutely no other origin."

A communist, Joliot was profoundly. The domestic environment, despite his relative comfort, had predisposed it in a very liberal and very generous attitude and it is that which has rendered little extraordinary his membership in the League of the Rights of Man and the Citizen, in the Socialist Party, in the Committee of Vigilance of Antifascist Intellectuals, etc... The influence of Paul Langevin would confirm him in this course, but it is very necessary to note that he made public, before his teacher, his membership in the French communist party. Invited in 1946, to expose the reasons of this membership, he responded:

> The history of the past and of the conditions of life of the societies, examined from the mutually responsible scientific and human points of view, naturally led me to communism. The communist party is the only one which is struggling in a "coherent" manner against fascism, against the egoistic and conservative minorities, for more liberty, progress, and justice. The communist party is stimulating strongly the initiative of each one with a view of a full utilization of the results of work for the material and moral well-being of men. It satisfies in this in the twofold task of personality and of mutual responsibility.

He is little from his intimates when the same of his relatives more distant that had not heard from his mouth the motivations of a choice of which he calculated perfectly well all the consequences. To Michel Rouze, his biographer, he explained in 1950:[1]

> What distinguishes man from the animal? It is that by becoming awakened he does not think uniquely to look for his snack, or rather, that one day when he will no longer be able to think uniquely about this. Today millions of men on earth must live as the animal, to look for before all their food and that of theirs. And myself...
>
> It is not that the civilization. It is not true that work imposed by food be a moral work. "You win your bread by the sweat of your brow," I do not want that philosophy. It is the exploiters who instruct him, those who live from the work of others. Should not science and technology permit each one to fee himself with very little work? We will be civilized when man will no longer need to work as he does in order to assure his subsistence. That does not mean that he will not do anything. To the contrary: it is then that his work will be moral. It is the work that he will do more, freely, to bring something to others, intellectually and manually, in order to enrich the life of humanity.

Likewise he often insisted, in the course of many conversations, on the importance of "democratic centralism" which has prevail in the heart of the communist party a true democracy.

It is not alone a sentimental reflex of generosity, it is especially the application of the scientific method to the study of the problems of society which determined it.

Thus it is that on January 28, 1948, in front of the Friends of Thought, he analyzed the role of "Capital"of Karl Marx:

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[1] F. Joliot-Curie, by Michel Rouze, p. 52.

> The permanence of the views and conclusions, the fruitfulness of the instruction that we find in this work as in all those of the great philosopher hold no doubt to the rigor, to the precision of the integral scientific method which he has admirably defind and applied to the study of social phenomena.

Likewise, let us retain this passage from the message which he delivered July 18, 1956, to the fourteenth congress of the French communist party (message reproduced on p. 227):

> As today appears in all its force and its abundance the immense progress due to the work of Karl Marx who knew how to release by the release by the scientific method the most important laws of the evolution of human societies.

It is convenient to compare the possibilites of action that the diverse social systems offer to men and to distinguish between the factors which side with human nature, with the very varied intellectual and moral qualities of men, and those which are inherent in the social system in which man lives and carries on his activity:

> In the capitalist system, a man possessing all the talents possible, but serving capitalism and applying its rules, is perpetually placed in situations which, at the best, can lead him to choose a solution less bad than the other for the large mass of his fellow-citizens and for his country. His behavior, for the main part, depends upon the system itself and not upon his talents.
>
> The socialist system, to him, never places the one who serves it in such situations. What of his actions results the best or the worst depends upon his talents and not upon the system. And to what degree it is a question of human talents, the society is the teacher be of modifying of man, be instead of replacing him.
>
> In the same way, an excellent scientist, reasoning in a logical manner, but to leave inexact foundations, is unable to reach any correct conclusions. If the premises are sound, to end at good or at bad conclusions will depend alone of scientific talents and we will be able to judge, to have confidence in him or not.

He was often indignant also about the fraudulent use made of the word "liberty" by the adversaries of communism:

> More than all else, we are in love with liberty, but not with the liberty which consists of exploiting one's neighbor, but the liberty pure of all hypocrisy, clean from all falsehood.
>
> We respect too much this word of liberty to use it carelessly. Liberty will be gained by our common effort. We are anxious to see disappear social injustices, misery, falsehood, degradation, and impoverishment inherent in the capitalistic system. By militating with those who are undergoing the most directly these injustices, we begin in one's proper place to contribute to their disappearance. Our liberty stems from this exalting feeling of efficiency.

In addition the historical analysis and the study of social laws, he found confirmations to his convictions by looking at the evolution of the U.S.S.R., since 1917.

At the time when the czarist regime, more the democratic bourgeois regime, overthrown by the joint action of workers and peasants, collapsed to give room to the power of the Soviets, Joliot was seventeen. As all young persons, he was open to new ideas and he took a deep interest in the social experiment which was unfolding in tragic conditions. As all young persons of this period, he was, wholly at the length of his active existence under the pressure for an inquiry solidly directed against a working and peasant class which had dared to free itself. He often expressed the hope of seeing gathered all the fatal predictions which had been formulated about the future of the Bolshevik regime, all the proof supplied by the "most distinguished economists" on the absolute impossibility of its survival, etc...

The day when the launching of the first man-made satellite from the earth opened the eyes of those who had until then believed all these official or inspired affirmations, Joliot gave the following explanation which appeared October 17, 1957, in Pravda:

> But the satellite has raised at the quarters of the scientists of the United States, of England, of France, a question much more serious: for which reasons it is precisely the Soviet Union, the Soviet scientists and technicians who have been the first?
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> . . . . . .
>
> It is necessary to say that certain ones were prepared for such a question, others (were) not. Those who had contacts with the Soviet scientists were acquainted with the extraordinarily rapid development of science and technology in the Soviet Union. But that is not all. It was going to be necessary to take into account the fact that in the U.S.S.R., the entire population devotes itself to a gigantic task, that it understands that the liberation of man, the true elevation of the well-being of men necessitates gigantic efforts in the domain of science and technology. Further, we must take into account, if we express ourselves thus, some "trend of the development of Soviet science and technology" in the course of the last decades. This "trend" did not know how to pass unperceived by the impartial observer who visited the Soviet Union at intervals of several years.
>
> . . . . . .
>
> The fact that it is the Soviet Union that had been the first to launch the satellite is not due to chance. The advance on western science was stressed from year to year. The same paths of the development of science and technology in the socialist countries distinguish them from those of other countries.

That errors, even very grave or criminal ones had been committed, seemed to him indisputable, but he had the conviction that in the socialist system the possibilities of correction existed by the very nature of this system and in this regard

the work of the Twentieth Congress of the Communist Party of the Soviet Union brought him a resounding confirmation.

Then his confidence was gradually enlarged as his visits to the Soviet Union showed him the rapidly ascending trend of the progress accomplished. He went to the Soviet Union in 1933, in 1936, in 1945, in 1949, in 1951, and finally in May 1958, three months before his death. Did destiny wish to furnish him, in the course of this last trip a magnificent confirmation of the confidence that he had always witnessed in the capacities for progress of the U.S.S.R.? Always, it is that he was received, on this occasion, in the Kremlin, for two hours and a half, bu President Khruschev. Only a direct co-worker of the latter and an interpreter were likewise in the office.

The conversation was interrupted at a given time by the ringing of a telephone. Khruschev neglected this call and continued the conversation. Someone knocked, opened the door, pronounced several words. Then Khruschev disconnected the device and at the end of several seconds, his face brightened with a large smile. Resting the device on its place, he got up and all while exclaiming, he struck Joliot vigorously with a hand on the shoulder, while the other hand was describing in the air large circumferences. The interpreter subsequently gave the explanation: the third sputnik had just been placed in its orbit!

IX

Man

While hearing pronounced the name of Archimedes, who does not himself immediately represent an absent-minded scholar leaving suddenly a bathing place in the simplest apparel and crying "Eureka!"?

Copernicus and Galileo evoked the first correct interpretations of astronomical observations and, also, the useless struggle of the Church against the discoveries of science.

The name of Newton inevitably evokes the falling of an apple while the one of Pasteur is always associated with the picture reproduced in all school textbooks and representing the scientist beside a young boy that he has saved from rabies. To this instinctive movement of the mind came to succeed some reflections on the course followed by the first to enunciate the laws of gravitation and on the succession of investigations which led the second to the study of the related virus by being left from crystallographic investigations.

How is it possible to imagine the thoughts of a physicist of tomorrow or day after tomorrow who, in the course of a bibliographical investigation will encounter this entry: Joliot F., and Irene Curie:

1) Artificial Production of Radioactive Elements.
2) Chemical Proof of the Transmutation of Elements,
J. Phys., 5, 153, 1934.

If procuring the bound volume of the Journal of Physics, it perhaps happened to him to interrupt his reading and let him go and day-dream. He will again see the young couple

photographed in white overalls in front of an installation that much--wrongly--looks already as being obsolete. And if it happened to him to study closely the scientific work of F. Joliot he will think afresh, as has Bruno Pontecorvo, his pupil, so well written it, "that this physicist had possessed to the highest degree scientific imagination, the 'spregindicatezza' as the Italians say, the capacity to recognize possible ones even the most improbable and strangest facts."

If this scientist preoccupied himself with the social implications of science and technology, he was pleased about that which at a particularly critical moment, he has found a man like Frederic Joliot-Curie, to define in its fullness the task of the true servants of science. If one does not share the philosophical and political opinions of Joliot, perhaps he will have reflections of the kind of those of one of his students and co-workers, Francis Suzor:[1]

> For those who have not shared his opinions, the renown of the scientist risks being tarnished by the action of the politician. In all the domains however, he brought the precision and the integrity of judgment without which, despite his inspired intuition, none of his discoveries in nuclear physics had been possible. His generosity pushed on to devote itself and to engage itself totally; this aptitude of his, he made it to the cause that he judged the best, that of communism. A Catholic myself, I had some long conversations with him in which we ignored nothing of our reciprocal convictions; even a stranger to his arguments, I appreciated his good faith and conserved for him my affection. He told me one day to have seen several of his friends lose the Christian faith and suffer of it, and he added that for his part his conduct and his work left him at peace with himself.

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[1] La Pensee, September-October 1959, p. 90.

> All these convictions, supported by his judgment, were also based on a gigantic extrapolation: he thought that humanity, in several tens of generations scarcely from prehistory, was in its first mumbling, and he was persuaded to work in the good direction and for its well-being. Refusing the religious faith, he had found to guide his acts another faith, in which were put into concrete form the high virtues of his heart and his mind.

For Francis Suzor, as for all researchers who have had the privilege to work under his direction, Frederic Joliot it was especially and before all the "Patron," the one to which is befallen the difficult task of assuring the existence of the laboratory and the work of the scientists.

One of the aspects of the role of laboratory director often remains unknown or undervalued by his beneficiaries... until the day when these accede at their turn in the direction post: it is the one which imposes the relations with the various administrations. The insufficiency of the credits, the remunerations plainly inferior obliges the one who wishes, at all costs, that the team be working at many undertakings, at compatible gymnastics which absorb time and exhaust strength. The material conditions were satisfied, it remains still to propose the subjects of work, to pursue and to direct the research.

> "Joliot managed to be acquainted with all the sections of laboratory life," wrote Pierre Radvanyi. [1] "Once each year, he assembled us all to inform us of the general problems, to discuss what was not going, to

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[1] La Pensee, September-October 1959, p. 85.

> organize such and such section of the laboratory, to distribute the tasks of collective interest, to introduce the new ones. (i.e. new laboratory workers)
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> . . . . . .
>
> He insisted in order that the discussion unfold also in full of the report. "One must not hesitate to interrupt, said he, in order to ask for an elucidation which allows to follow the stream of thought, in order to ask a question, even the one which may seem stupid, in order to add something." And his manner of directing these gatherings was extremely stimulating...

But that is still not sufficient: to the contact by groups, to the discussion of results, to the establishment of programs, one must add the human contact with men and women from very diverse (walks of life.)

> Once entered in his office, they were forgetting those, perhaps, waiting before the door in order to be received in their turn. I must say that, for my part, I never entered in the office without a beating of heart and I never proceeded without having material in reflection for several days.

All those who have had the occasion to participate with Joliot, alone, together, or in the course of conversations with several persons, at scientific, political, or artistic discussions, will preserve a concise souvenir. It is the one of the moment in which he succeeded in putting in place again the problem envisaged in the largest perspective, to give him an unsuspected insight and to work then some unforeseen possibilities of solution.

This feeling of having, in common with him, enriched his acquirements and ameliorated his own vision of the world, was at the base of the deep confidence that he knew how to create around him.

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For the worker, for the peasant, for the merchant, for the student, in France or in other countries, that may even bring forth, that will be well able to mention the name of Frederic Joliot-Curie? The answer to this question is not doubtful for those who have been able to observe in Paris half vacant in the middle of August, the slow pilgrimage of thousands of men and women who, two days continuing, came to kneel before the catafalque of Frederic Joliot-Curie, at the Sorbonne. Certain eyes were swollen with tears, others reflected a manly determination. Some women knelt down and crossed themselves, some men removed their hats with pride. They were all come there, the heart heavy with sadness and burdened with gratitude with regard to a scientist whose discoveries, for many, were known only by name. But the homage was going to the scientist who had not only made science progress and worked for the development and the prosperity of his country, but who had known how to abandon his ivory tower and come fight in the midst of those for justice and peace.

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For his intimates, for his friends, for all those who have, little or much, lived at his side, Frederic Joliot, "Fred" as all called him, was a being of facets, as all gifted beings. He would win you over because he understood, was conscious of, and loved his fellow-men on the single condition that they not have lacked sincerity.

He loved music much and could remain for hours improvising on the piano. He recorded himself on magnetic tape and received a mischievous pleasure when he auditioned himself asking his dumbfounded or embarassed interlocutor whether the piece was by Mendelssohn or Beethoven! He gladly discussed music, not only with his son Pierre, but also with a scholar of this art--who was his friend--George Leon. The latter has expressly wished to confide to us below, his impressions of Joliot, the musician:

> Joliot was an artist in the form of a complete, honest man. With the resolution made to know how and not to judge that with which he was acquainted. Disposable to all that one proposed to him: a sonata, a ballad, a crayon, an etching, or even a symphony.
>
> He had no ill-will, he had ideas. He tried at first and understood afterward. Somewhat in the manner of Francis Couperin who said: "I prefer that which touches me to that which amazes me."
>
> Joliot did not know music, he liked it and it is somewhat that which conferred to this man of science the unspoiled power of the good public. To acknowledge what one offers, without restriction, at first sight.
>
> He decided however, but never before having received. He was enthusiastic and sometimes naive. He had no "gods," but he had bursts of enthusiasm. His only denials came, no doubt (I think here in modern music and in what he said about it), from that which he had not the time to devote himself fully, in this domain, to a genuine discovery. From these denials, the word is perhaps a little strong, often sprang a game. If it was inconsistent it was much for learning about others. In music, Bach, Beethoven, and Mozart were his preferences. He spoke often about them, listened to them, and sought to persuade his friends with his reasons for liking. Thus he reunited all at once the scientist who proves, the lover who is elated, and the advocate who pleades.
>
> The artist Joliot was the self-same youth. Not by his choice, but by his enthusiasm which could lead him to proselytism. One cannot forget, having once heard, as he talked about Bach for example, whom he had had discovered to the fishermen of l'Arcouest one summer evening.
>
> One cannot forget the way which he had to hear, then to thank again, several artists who came to his

home, to play in all simplicity, led (hither) by friends, for him to pay a visit. His joy caused pleasure. His sincerity moved. It was in the image of his welcome. He was the host in all ways. He knew how to welcome.

If he had had the spare time, Joliot would have acquired a vast musical education. He did not stand the half-measures. He could not allow that one speak and decide before him without genuine knowledge. That which he required of his friends, of his interlocutors, he required of himself. He was allowable to those who came near to him to understand quickly. His unreasonableness was severe for art, the artists, his own pastimes. It is why he spoke really only of what he knew. That which never prevented him from seeking in the opinion of others new reasons to understand and to appreciate. Because he valued effort, because the conviction of others to forbid inclinations which were yet to him foreign, interested him more than it puzzled him.

I have often had the experience, when for example, I brought up before him my taste for modern music. When one told him that he liked a work, an author, it did not suffice for him to know only. He wished that this taste be fully justified. If it happened not to be in accord with him, he seldom decided, said less "I do not like" than "I do not understand."

His profound intellectual and moral honesty thus guided him to listen, to see, and to decide. But, also, to participate. Whether it be a question of music or painting.

When he was seated at the piano or was painting, Joliot was the reserve. And yet he had prodigious romantic enthusiasm.

We knew that with Bach, Mozart, and Beethoven, Mahler was one of his favorites. That explains the man much more than it seems. Those who were witnesses of the pianist improvisations of Frederic Joliot preserve the memory of an innate virtuosity, of a stupendous velocity. His right hand was rolling in arpeggios, the left one knew how to aid in the equilibrum. When he applied himself at this "hobby," one felt approaching the shade of Schubert, of Mendelssohn, and of Chopin. Nothing was calculated, all, nevertheless, "fell" exact.

His love of nature was revealed in many circumstances. And he was an artist already when he talked about the mountain and the sea, of his boat and the

> crags, of the snow and the flowers. Of one flower particularly which he had kept for a long time and of which he was proud. He had picked it, he told us, in New York, one day, between two paving-stones.
>
> To hear him bring up his astonishment, one had the revelation of the poet Joliot and (as a) poet he was in each instance without vanity, but because it was his state.

Another of his intimate friends, Jacques Adnet[1] was often his confidant in matters of poetry.

> Fred loved unaffected work, relating to mankind, even in that which mankind can have torturing: I remember his enthusiasm for Edith Piaf.
>
> He liked poets very much, but only the simple poets, who have a music... Poetry was our denominator common to Irene, Fred, and me. I still see Irene's reciting with a sweet and even voice the "If (plural)..." of Kipling.[2] He loved life, the genuine beings; he embraced their language and was rapidly on the level with them.

When the sickness, then the convalescence obliged Joliot to travel less, to work less in the laboratory, to take prolonged vacations, he began painting, naturally with the largest number serious. He thus did only let himself go to an inclination acquired all along from his youth in the contact of his sister, the painting of flowers, and from the surroundings of artists with which she kept company.

> "We have had often together long conversations about painting," Charles Lapicque confided to us. "Fred has not been able to devote much time to cultivate himself in this field, to visit the expositions or the museums, so that his preference is inclined, on the whole, toward works presenting the world in a rather literal way. He had the honesty and the modesty to excuse himself from it sometimes, notably

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[1]Director of the School of Decorative Arts.

[2]It is suitable to recall that Irene Joliot-Curie translated into French the poems of Kipling.

when he was describing himself. He wished to describe conscientiously that which he was seeing. It was there, said he, a first necessary step, before flinging oneself into the transposition of the semblance. In fact, the paintings which he converted into money give by no means the impression of investigations, but of finished works, which show with a keen sense of nature, and are not without resemblance to those of the artists designated "naive," although, as a matter of fact, does not play a preponderant role in one nor the other instance. It is rather to a certain form of deep-rootedness in his life that it is suitable to attribute this tendency. If Beauchant was a gardener, Frederic Joliot suborned hunting, navigation, and fishing with a passion that did not leave any place at all for very long plastic mediations, but was coming to infuse on his canvases, on the ground, and on the water, a reality that the simple contemplation would not know how to produce. I particularly like his "Passing Through Auvergne," for the presentation of the countryside that it brings to us, and also a view of the Bay of Launay, portrayed from the terrace of his property of l'Arcouest, where the sea, the sky, the boats at anchor and the head of the Trinity are of a truth thrilling.

Although he had shown, in general, little attraction for the pronounced pictoral transpositions, so much ancient than modern, he sometimes penetrated their mechanism in a surprising fashion for the one even that he was the author. Thus, one day while I was showing him a series of maritime canvases in which one saw boats imbricated and enveloped in curves in the shape of eight reclining traces forming the waves, he felt at the first that these strokes were not arbitrary and were taken to reflect on their origin. These lines, he tells me at the end of a moment reproduce with justice the movements of the stem-post (of a ship) which, raised with a portion vertically in the crossing of each emptiness, is at the same time carried away laterally by the impact of the same emptiness against the flank of the ship, that which produces this projection decorated with festoons which is none other than a "figure of Lissajous."

I had in reality proceeded from instinct, but his interpretation seemed to me convincing, that I made it mine forthwith.

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Another category of documents projects a sharp light on the personality of Joliot.

As a physicist, "he noted in his notebook all the details and circumstances of the experiment, understood there what could a priori seem insignificant, and recommended to others to act likewise."[1]

On the outside of his laboratory notebooks and from the private journal pages already mentioned, one finds in the records left by Joliot a small notebook of paper divided into squares, with a blue cover, entirely covered with his small writing, and sometimes difficultly legible. With the exception of three pages of computations on "the height and the hour of the tides," it is a complete diary on his sojourns at l'Arcouest from 1953 to 1956 included. Day after day, there is noted the atmospheric conditions, pressure, the direction of the wind, the state of the sea, the displacement of his boats, the victories or the defeats in the regattas, and, particularly, that which excited him as much as physics, the results of his fishing.

Thus it is that on August 24, 1953, he writes:

> Racks raised great morning. 10... One small lobster. Wind S.W. very strong, sun, clouds, pressure 759 morning, evening 762.
> Thursday, August 4, 1955:
> Morning splendid, wind E weak. Day splendid. Made the rounds after having lunch with Irene at the home of the Fourniers. Very beautiful view on the Trieux. Concluded the communique for the World Council... I am going to see Labour and he is happy if I work with Jean Colin of whom he tells me the greatest good.

Labour, Colin, two sailors having sailed on all the seas of the world. And when Joliot embarks, works, discusses with them, each of the partners has the impression of being in a

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[1]Pierre Radvanyi, La Pensee, No. 87, p. 87.

family, in the company of a comrade who knows and loves the sea, who condenses the slightest shades of meaning, who observes the horizon and interprets in the same way the breeze which rises or the clouds which form.

On board, there is no Labour, the sailor, and Joliot, the physicist, there are two sailors. With the same manner, when Joliot, in a factory, in France or in a foreign country, stops and converses with a group of workers, foremen, engineers, in several minutes each will find himself at ease, will understand his interlocutor and will feel himself completely understood by him. But let us return to the diary:

September 12, 1955:

> Six o'clock, part clear, part overcast--go to the watch--position culinary captain[1]--Misfire a rabbit in the bale at forty meters--Again pull back the strings (of the bows) with Colin: one small ray, two red mullets, two veterans, one button of an oar (rack one beautiful dorado coryphene and a medium-sized conger eel) wind strong from the north...
> In the evening, I place 6 collets in the kitchen stove of the captain.

On July 6, 1956, Joliot comes back to l'Arcouest for the first time since the death of his wife. And he remarks in the notebook:

> Departure Paris 8:10 a.m. ...
> The weather was clear and very beautiful at l'Arcouest. Arrived at 5:40 p.m. The house is in perfect order. Have dinner and listen to radio with Helene. Headline Euratom! It would be necessary for me to write Guy Mollet. But is it worth the trouble! Irene misses me much. Gone to bed at 9:30 p.m. and asleep a hypocrite at 10:00 p.m.

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[1]The "Captain" was the historian Charles Seignobos, who, the first, had built for himself a house on the "point of l'Arcouest" and whose boat l'Eglantine reassembled all the days of the summer... an important part of the Sorbonne.

And the last lines, dated Wednesday, September 14, 1956:

> Balance sheet, bad time of summer, very content with Helion.[2] Lobster fishing exceptional.

In 1950, Joliot, conversing freely with Michel Rouze[1] did a self-portrait which will surprise only those who have not come near him:

> I am not made for being an intellectual: I have owed learning in being it. I am a little astonished being among them. My life to me, it would be the life in the mountain or professional fishing. It is for this activity that I am made. The other I have owed to make myself it. When I must prepare a speech (I do not begin to speak as that all of a sudden, for that, that goes), it is always difficult. To prepare my strategem, that has an immediate meaning, that engages only me. The expression of my thought to the outside, that risks engaging people. It is a responsibility, consequently a greater effort. When I must write, I have a terrible care of paying attention. Other intellectuals write easily. If you had seen rough copies! On one page, there are three sentences which remain...

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For all those who have had great prosperity, would it only be a time, to spend Sunday afternoon in the home of Joliot, Lenotre Avenue in Antony, two things are certain. They will preserve an affected memory of it and they will have the sentiment that alone, they have been able genuinely to know and to appreciate the two exceptional beings so closely united in life and so prematurely reunited in death.

In the large living room, decorated with paintings, busts, hunting horns of his father, and fishing trophies, or on the herb in the garden, the circle is formed, but each one goes

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[2]One of the boats of Joliot, another was christened St. Just.

[1]F. Joliot-Curie, by Michel Rouze, E.F.R., pp. 51-52.

and comes in his manner, the hospitality being so complete and so natural that it is impossible to discern those who receive from those who are received. The conversation is animated... but for being objective it is appropriate to state precisely that it adorns for the nine-tenths of the time of a monologue of Fred Joliot, interrupted with brief questions or simple remarks, and that, in order to constitute a resonant depth, Pierre Joliot will have made ready on his record player a record of Jean Sebastian Bach. It often will happen that one of the friends present has had in the days which preceded a particularly grave anxiety or was being in the face of serious difficulties. The moment will come all naturally in which he is alone, aside, with Fred, with his intuition all feminine, will have "felt" all that which he experiences and will have known how to say to him the words which calm the uneasinesses, again warn the heart, and give courage again.

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For myself the name of Joliot brings to mind fully all that which is contained in this word: friend.

It would have to have been necessary for the genius of Montaigne in order to write that which thirty-eight years lived side by side, in joy as in distress, in the trials as in success have exhibited human enrichment.

But the description I have undertaken of the life and work of Frederic Joliot will have attained its object if beyond the scholar and soldier, it has allowed to perceive the man profoundly human and profoundly good.

CONCLUSIONS OF THE REPORT
OF PROFESSOR JOLIOT-CURIE
AT THE MEETING OF THE NOBEL PRIZES

I would like, before concluding, to have you share part of several reflections that the conditions of the work of current research have suggested to me.

For the more than thirty years that I have been working in the laboratory, I have been the witness of a transformation, at first rather slow and now explosive, of the working conditions of those who devote themselves to basic research in nuclear physics.

There has been hardly twenty years, artillery utilized to explore the atomic nucleus could hold in a bottle of several cubic centimeters. Such and such experiment having given some results of an extreme importance, necessitated only a small space, several meters square and a material less volumnous. The researcher, whose mentality in my opinion must be similar to that of an artist, feels himself close to the phenomenon studied. Observation was rather direct. The researcher could let run free his creative originality. He could without large expenses or risks for his companions of the laboratory, progress by successive erasures and attain the goal. Sometimes, a wind gust, similar to the poet, carries him toward discoveries.

Basic research had, in a certain measure, the artistic character so favorable to the expansion of personality.

The necessity to explore more and more deeply matter has led to inventing technical means more and more powerful, of which many are volumnous and complex. Rapidly, the artillery launching

the projectiles: high voltages, cyclotron, betatron, synchro-cyclotron, synchrotron, volumnous and heavy devices, takes place in the laboratory. A numerous technical personnel became indispensable in order to assure its functioning.

A modern center of basic research in nuclear physics presents, at first sight, to the uninformed visitor, an industrial character. Does not the researcher risk feeling overwhelmed by this arrangement most certainly indispensable, enormous and expensive apparatus, whose cost for several hours functioning mounts to tens, even hundreds of thousands of francs. He does not feel himself free to proceed by erasures as formerly. He feels his responsibility strongly to understand a task. To experiment with little chance of success, simply "in order to see," introduces now genuine difficulties and yet is it not often a surprise?

In this transition of the artistic ladder to the industrial ladder, it seems to me indispensable of being conscious of these dangers and of finding the conditions of utilization of the equipment that do not choke the personality of the researcher. One cannot do original work chained up.

SEVERAL REFLECTIONS ON THE HUMAN VALUE OF SCIENCE[1]

This article does not have another intention than to have you share several thoughts which have come to me in the course of my life as a researcher, on the human value of science, and the attitudes, often contradictory, of men toward it.

The human value of science, in all its most diverse aspects, has been the object of numerous writings and, for that which concerns me, I always keep alive in my memory the magnificent preface of Paul Langevin in the collection "Human Evolution,"[2] the fine lectures of Jean Perrin so rich with ideas and poetry,[3] the books so profound of my colleague and English friend J.D. Bernal: The Social Function of Science, The Freedom of Necessity.

It is impossible for me to cite here all the other writings which have deeply had an effect on me, nevertheless, I will cite still two of them that I find remarkable, one, little known, of Victor Hugo on art and science, the other of Louis Pasteur on the future of French science, published in a set whose vivid title is In the way some texts forgotten.[4]

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The work of the past, in the domain of thought, is such

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[1]Article published in La Nef, No. 2, January 1957.

[2]Human Evolution, descent to our day, Preface of Paul Langevin, Librairie Aristide Quillet, Paris, 1934.

[3]"What modern civilization owes to disinterested science," lecture broadcast of Jean Perrin, National Station Radio-Paris.

[4]Louis Pasteur, For the Future of French Science (1871), Preface by Jacques Nicolle, Coll. "In the light of forgotten texts" (Editions Reason for Being, Paris, 1947).

an amplification, that it goes beyond the capacities of a human intelligence. At each moment, ignoring the past, one recreates--sometimes while becoming impoverished, but often while enriching--until that which the just thought have become so familiar that it becomes then natural and easy to pass with common action. If, most often, it is the needs for action which pose the problem that the thought tries to resolve, this one, as Paul Langevin liked to say, "is of an extraordinary fruitfulness in order to creat new possibilities for action... no effort is spent for action." But the processes of fruitfulness between the present being and the external middle class, the transmission of the thought to the action of the multitude, we appear with a great delay and a feeble efficiency.

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It is important to investigate the causes, certainly numerous, of these characteristics, but I do not intend to proceed here in that study. I still succeed in convincing myself that methods are not of as a great delay that it seems to us, that which does not signify absolutely that we must not exert ourselves without delay of accelerating them. Some examples as those of the printing office, of the reform rendering education compulsory for all, are there in order to encourage us in these efforts. Which benefits will we be able to attain from a reform which caused the University to open very widely its doors to the sons and daughters of workers and peasants! Thinking back on the fact, that presently, several for only a hundred of the students

who attend our universities are the children of millions of workers and peasants, as a matter of fact of the great majority of the French people.

Let us come back to the estimations of the speed of the methods envisaged. This one depends before all on the target dates we choose. Each individual imagines, to estimate the time, a unity which is a very rough means of the necessary durations in order to accomplish some work of noteworthy importance, of which he is the actor or witness from the beginning until the conclusion. I state precisely that I intend by "noteworth importance," such realizations, that one keeps of it the memory lasting all his life. This unity, in several years, is a relatively feeble fraction of the middle-aged life of individuals. We are now living in the duration of this kind with projects called: five-year, ten-year... they stop there in general, no doubt because man likes to see the completion of his efforts. Ten years already represent a large fraction of the duration of a human existence.

To undertake a work of which one will not see the completion, of which will be the beneficiaries only the descendants, is not yet in the reach of all the world.

If we consider now the changes concerning the important human common ownerships, we are led, in order to calculate the time, to choose a unity of more eminent duration, of the older of the one of a generation, let us say: some thirty years. It is, I believe, a unity of this order that is suitable to choose

to appreciate the swiftness of the progress which preoccupies us. You understand why I do not find them as slow as one thinks in general, when you will reckon with me that in scarcely two hundred generations we have been separated from prehistory... six thousand years! Two hundred grandfathers until us, and the immense progress accomplished appears to us then rapid.

The great events of history will seem to us closer, more accessible, if we mark them by the number of generations which separate them from us, rather than by dried-up dates expressed in years.

This simple calculation makes the extreme youth of thinking humanity appear and can explain, in a certain measure, the faults that it has committed and that, alas! she commits still! To the degree of maturity to which we can already lay claim, none will know how to justify a goodwill for repetition of these faults of youth!

The duration of a generation is not, in its turn, an adequate untiy in order to value the one, considerable, necessary in all important organic evolution of living beings. It is by hundreds of thousands of years that one must compute. These durations are still very small in front of the four to five billion years since which the universe has taken the look as we know it today. One can, in effect, think that in a certain period all the bulk of the universe was concentrated in a ball of a stupendous density and whose temperature was increased continually because of the liberation of energy of nuclear origin. In a

moment, the temperature became such, that the ball exploded into myriads of fragments which make up the stars that we observe today in the sky.

For that which concerns the continuations of existence possible for living beings on our planet, one must count, except mishap, by thousands of billions of years. In effect, hydrogen, constituting the water necessary to life, escapes continually from the earth at a known rate; it results from it the immense reserves in the oceans and the rocks exhaust themselves and, knowing roughly their importance, it is possible to estimate the duration necessary in the complete exhaustion. It is a question of very rough estimation because it would be necessary to take into account the formation of hydrogen to leave heavier elements transmuted by the various cosmic radiations which strike the terrestrial surface. These radiations themselves contain nuclear protons of hydrogens atoms.

Which stage of evolution will we have attained in thousands of billions of years if nothing, before, comes to totally destroy our line?

I think that durations as considerable are not all human judgment and it seems to me vain to anticipate on a future as remote. Is not it a question, in effect, of durations of thousands of occasions more grand than the ones which separate, in our evolution, the unicellular from the one which characterizes us today?

In the case where, well before, a grave menace for humanity would appear on the earth, we would have been able to be led, in order to assure the preservation of the race, to swarm on a planet of a star perhaps very distant. It would be no doubt necessary to be in danger in order to try to leave the earth. Are we not always pushed forward by our insatiable curiosity and our taste for adventure? But here I am already in anticipation. Permit me to pursue it briefly.

In view of assuring a maximum gain for this long voyage, it would be pointed out not to embark in the rock that passengers provided with several bottles, of which it is needless to state precisely the contents. One is right in thinking, science progressing rapidly in this domain, that it could even be unnecessary to send passengers, ovules and bottles would suffice. One can also think that one will have succeeded in provoking parthenogenesis. But it would be very necessary to refrain from not sending at the same time these famous bottles in view of utilizing them for reproduction at the end of the voyage.

Without this precaution, the population which would develop on a planet would be exclusively composed of women.

All that is very complicated, and let us return wisely--if I dare say--to the first plan which rests in the framework of knowledge acquired today.

If the duration of a voyage exceeds the duration of life, it would be wise to preserve in the cell only descendants of the female sex which, of the two sexes, is capable of bearing. In

brief, one will preserve in the rockets, with the bottles, only the beings indispensable to the perpetuation of the race.

Arrived on the new planet, the first boy which would be born would be preserved. As for the following... I am unable to anticipate. The passengers, first inhabitants of the new planet, will find themselves the best means of assuring the future of the race. All that which I can say is that, on this planet, it would be no doubt difficult to have believed that man has been created before woman!

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Several hundreds of generations ago, man was organically little different from what he is today. His great intellect would all ow him reflection and word. With several rough tools, he lived in the fear of a hostile and mysterious world: to struggle against the animal in order to assure each day his sustenance and that of his close ones was no doubt the principal preoccupation of our remote ancestors. A mere trifle near, this existence is that of the animals we observe. If the bird sings in the waking hours, he goes away soon without delay and fetches his food and, if he stops several days, he dies.

Is it very differently of our time for a great number of human beings? The obsession with unemployment which famishes, does it not still exist in numerous countries which declare themselves to be models of civilization? But let us pass on.

Primitive man found in the brief moments of security a tranquility sufficient in order to act without immediate

utilitarian preoccupation. Such engravings on ivory and such paintings on the walls of the caves we furnish the evidence of an intellectual life. It is no doubt men, possessing a quality of mind of the same order that the one of these primitive artists who turns sour, by observation and experimentation, improves progressively the conditions of material existence of his fellow-creatures.

However, superstitions, the terror of invisible powers dominated their souls. The forces of nature were incarnated in divine beings so much more powerful that their manifestations exceeded the gradation of human forces and this state of things was prolonged for many generations during which the fear of the anger of the gods raised to man all reason to search for an explanation of the external phenomena in view of dominating them and utilizing them. This terror was a genuine moral pain to which were added physical suffering, sickness and hunger. Several generations still, to leave these dismal periods, and there are that appear the first liberal doctrines of the Greek philosophers and moralists. It was truly in this epoch that science appeared. The doctrine of Epicurius, "the physical Epicurian," tended to liberate men from the fear of the gods, these, before the dignity of their tasks, would be indifferent to human affairs.

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The more recent history of our society shows incontestably all that which civilization owes science. The struggle against sickness and hunger, the subjection of the natural forces and

the liberal diffusion of knowledge have been conducted often with success for the greatest benefit of humanity.

It is particularly convincing in this regard to consult the statistics of human mortality. I have been able to have in my possession the ones, beginning in 1591, of a town of Europe.

In the course of the sixteenth and seventeenth centuries, the mortality rate, in this town, remained in the vicinity of three to four per one hundred inhabitants, with the exception of uncommon peaks in 1599, in 1626 and in 1657. For these years, the proportion of deaths reached twenty or even thirty per cent; the large epidemics were cause of it.

One can infer of it that in the periods of the epidemics of plague and of cholera, a third of the population, that which is considerable, of Europe, and perhaps of the world, was destroyed.

The epidemic attacked as many of the rich as of the poor, and defensive measures, science helping, permitted to strangle and to suppress these great plagues, at least of a large part of the world.

This victorious struggle did not however make the fluctuations in the security of human lives disappear. The statistical curves, indicating the variations of fear and collective fear, the important social happenings, the wars, have roughly the same pace as those which indicate the deaths.

The causes of these new fluctuations began to be combatted seriously only after the liquidation of the great epidemics.

Unemployment and poverty do not menace differently all individuals as typhoid fever, the plague or cholera. It is probable that if misery were infectious, it would have already been suppressed.

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Science is not only capable of increasing the duration of life, but yet, by the marvellous techniques that it had born, of rendering the happy existence.

The men who benefit from the results of science in every instant of their life, but who, alas! are still too often the victims, must be informed of that which the reserves of the present time could, from now on, bring them immense benefits.

It is now a small fraction of human beings who profit first of the new techniques and, in order to soothe the desire of the crowd, it knows how to have glitter, by its bold anticipations, the marvels that will bring science to all... in the year 2000! the multitude, in general, profit from technical progress only after long delays. One speaks already of trips by rockets... but who, at the present time, travels by airplane?

A large diffusion of the results of science would permit all without delay to lay claim to the benefits of science and to oppose with force the turnings away of science toward works of ruin and death, toward selfish profits.

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Would it then suffice, as it has been suggested, to close the laboratories, to suppress the means of work for the scientists, to default of hanging them, and to being content to exploit knowledge acquired judged largely sufficient?

Nature would undertake, sooner or later, of making us examine grievously the error of such conduct. It is certain that we would be prey to some most tragic difficulties still if science never progressed again.

Turning ourselves toward the future, we know, for example, that the known resources of energy on the earth are rapidly exhausting themselves. It is important to bear it in mind and to pursue research which will cause new ones to shoot forth.

A bacterium can, tomorrow, attack the human species and endeavor to destroy it, as other species which have already disappeared. There exists a marine herb, the zooster which, in two years, has almost completely disappeared from all regions of the globe. This destruction has had important consequences as the modification of marine depths for vessels, along the coasts, and the very sharp reduction of the yields of coastal fishing. This scourge which has struck an herb can, tomorrow, pounce upon man.

In order to combat effectively these possible calamities, we must accumulate a considerable reserve of scientific results.

Not only would it be foolish to wish once more to enchain Prometheus, but we must, on the contrary, apply the scientific mind to find solutions to the difficult problems of our existence.

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Perhaps more than all other human activity, we owe science the consciousness of collective effort. In order to speak only about basic research, the results of the latter, by the rapid

diffusion of scientific information, becomes the common property of all the scientists of the entire world. There results from it a fruitful solidarity between the researchers of the diverse nations.

Every new acquisition obtained in the laboratory put back in our memory the list, often long, of the scientists, gone on or contemporary, of the effort of which our work is the result--and, very often, the fame is attached to a scientist who had only put the last touch on the common work of all an association of investigators. Likewise we experience a feeling of joy while thinking that our work will serve our colleagues of London, New York, Moscow or elsewhere. It is for these reasons that I find excellent the habit that scientists have taken to entitle their recollections "Contribution to the study of...." Because it is always from a contribution of which it is a question, even at the time of the great discoveries which indicate the discontinuities of our knowledge.

Also, all tentative of limitation or of stoppage of the diffusion of scientific news does it represent an extremely grave danger for the progress of science and for civilization.

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Science, and it is one of its highest titles, is a fundamental element of unity among the thoughts of men dispersed on the globe. It is not, in my opinion, from other human activity for which agreement between men be always so certainly acquired. Scientific observation is interpreted by the same processes of thought

whatever be the longitude or the latitude. And one can think that it would be likewise at the residences of other beings alive in our universe, if they exist, if different from ours that be able to be their shape, if they are endowed with the faculty for thinking. It is there an aspect of the universality of science.

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Victor Hugo said:

> ...science is going unceasingly erasing itself. Fruitful erasures... Science is a ladder... poetry is a beating of wings... An artistic foreman is an occasion for all.. Dante does not eclipse Homer.

The artistic foreman certainly has a character more unalterable than the scientific creation, but I am convinced that the variables which guide the artist and the scientist, as well as the qualities of thought and action required, are the same. The scientific creation with its highest summits is also a beating of wings... the artist and the scientist are joined then in order to create, beneath all their forms, Beauty and Happiness, without which life would be only dreary movements.

The man of science is like the worker or the artist who constructed the cathedrals. The latter participated in a work which, sometimes, necessitated the work of several generations without that diminishing their ardor or their love of which they could not see the result.

Several magnificent buildings, several works of art will be able to allow us the present technique if we accepted to understand, not only for our use, but for that of the generations to come!

Science gives to the one who serves it grandiose perspectives; it is a work to which the scientist contributes each day without having the vain desire of himself seeing the completion.

The benefits that humanity draws in every moment from the collective effort and the accumulated efforts in the course of time, from the effort of each human being during his brief existence, exalting our confidence in the ascent of man.

(Here is intercalated the paragraph quoted on page 155.)

To conclude I would wish to affirm my confidence in science and in man. Despite some serious errors that the latter commit still too often, I am convinced, as Pierre Curie, that every new conquest of science will bring definitely more good than bad.

Scientists are perhaps more in a position to imagine with certainty the immense joy of living that science would bring to all human beings in a world of justice and peace. Yes, there is at each moment "happy news" which they would bring to their brothers--of the news which pursue forever the terrible obsession of the great plagues, of the sicknesses which kill every day men, women, children in full force--of the news which bring back to very little time the duration of the compulsory drudgeries in order to assure life--of the news which will allow each one--materially liberated, to procure the supreme joy of discovering and creating.

A NEW TYPE OF RADIOACTIVITY[1]

We have recently shown, by the Wilson method,[2] that certain light elements (beryllium, boron, aluminum) emit positive electrons when one blasts them with alpha rays from polonium. According to our interpretation, the emission of positive electrons from Be would be due to internal materialization of gamma radiation which the positive electrons emitted by B and Al would be electrons of transmutation accompanying the emission of neutrons.

While looking for to state precisely the mechanism of these emissions we have discovered the following phenomenon:

> The emission of positive electrons by certain light elements radiated by alpha rays from polonium exists for more or less long periods, being able to attain more than half an hour in the case of boron, after the removal of the source of alpha rays.

We place a sheet of aluminum 1 mm from a source of polonium. The aluminum having been radiated during about ten minutes, we place it above a Geiger-Muller counter carrying an opening sealed by a screen of seven hundredths of a millimeter of aluminum. We observe that the sheet emits radiation of which the intensity decreases exponentially as a function of the time with a period of three minutes fifteen seconds. One obtains an analogous result with boron and magnesium, but the periods of subsiding are different, fourteen minutes for the boron and two minutes thirty seconds for the magnesium.

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[1]Statement of Madame Irene Curie and Mr. Frederic Joliot-Curie, presented by Mr. Jean Perrin. This statement announced the discovery of artificial radioactivity. It appeared in the reports of the Academy of Sciences, session of January 15, 1934 (vol. 198, p. 54).

The intensity of the radiation (immediately after the exposure to the alpha rays) increases with the time of radiation until a limiting value. One then has initial intensities of the same order for B, Mg, Al about one hundred fifty impulses per minute in the counter using a source of polonium of sixty millicuries.

With the elements Li, C, Be, N, O, F, Na, Ca, Ni, Ag, not any effect has been observed.[1] For certain of these elements, the phenomenon probably does not occur, for others the period of subsiding is perhaps too short.

The experiments made by the Wilson method or by the method of the trochoid introduced by Thibaud demonstrated that the radiation emitted by boron and by aluminum is made up of positive electrons. It is probable that it is the same for the radiation of magnesium.

While introducing copper screens between the counter and the radiated sheet, one finds that the major part of the radiation is absorbed in 0.88 g/cm^2 for Al, 0.26 g/cm^2 for B and Mg, that which corresponds, by acknowledging the same laws of absorption as for positive electrons, with an energy of 2.2×10^6 eV for Al and 0.7×10^6 for B and Mg.

When one reduces the energy of the alpha rays radiating through aluminum, the number of positive electrons diminishes, but the period of subsiding does not seem modified. When the

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[2] Reports, 196, 1933, p. 1885; Journal of Phys. and Rad., 4, 1933, p. 494.

[1] This phenomenon cannot be due to a contamination by the source of polonium. (Statement of the authors.)

energy of the alpha rays is reduced from 10^6 eV, one observes almost no more of these electrons.

These experiments demonstrate the existence of a new type of radioactivity with emission of positive electrons. We think the course of emission would be the following for aluminum:

$$_{13}Al^{27} + {}_{2}He^{4} = {}_{15}P^{30} + {}_{0}n^{1}$$

The isotope $_{15}P^{30}$ of phosphorus would be radioactive with a period of 3 minutes 15 seconds and would emit positive electrons accompanying the reaction:

$$_{15}P^{30} = {}_{14}Si^{30} + {}^{+}_{e}$$

An analogous reaction could be envisaged for boron and aluminum, the unstable nuclei being, $_{7}N^{13}$ and $_{14}Si^{31}$. The isotopes $_{7}N^{13}$, $_{14}Si^{27}$, $_{15}P^{30}$ can exist only rather short times, it is why one would not observe them in nature.

We consider as little likely the explanation following which

$$_{13}Al^{27} + {}_{2}He^{4} = {}_{14}Si^{30} + {}_{1}H^{1},\ {}_{14}Si^{30} = {}_{\ }Si^{30} + {}^{+}_{e} + {}^{-}_{e}$$

the isotope $_{14}Si^{30}$ being excited and being able to deactivate itself in the course of time, energy would be materialized and giving a pair of electrons. One does not observe emission of negative electrons and it is theoretically very improbable that the difference of energy between the electrons be sufficient in order that the negative ones not be observed.[1]

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[1] Nedelsky and Oppenheimer, Phys. Rev., 44, 1933, p. 948.

On the other hand this course would suppose a duration of the excited state extraordinarily long with a coefficient of internal materialization unity.

Definitely it has been possible for the first time to create with the aid of an external cause radioactivity of certain atomic nuclei being able to persist a measurable time in the absence of the exciter cause.

Durable radioactivities, analogous to those that we have observed, can no doubt exist in the case of blasting by other particles. The same radioactive atom would be able no doubt to be produced by several nuclear reactions. For example, the nucleus $_7N^{13}$ which is radioactive according to our hypothesis, would be able to be obtained by the action of a deuteron on carbon, after emission of a neutron.

HEARING AT THE ECONOMIC COUNCIL

On Thursday, May 24, 1956, at 10:30 a.m., Professor Joliot-Curie was heard at the Economic Council, by the Committee for Work for the study of atomic industry. The meeting was presided over by Mr. Wolff.

In the course of an authoritative speech which lasted more than two hours, Professor Joliot-Curie approached the problems of the energizing equipment of the country, the conditions of scientific research and the formation of plans.

Past events and the lessons it is convenient to draw from them, as well as the perspectives of the future were exposed in this document of internal order, of which the President of the Economic Council has well wished exceptionally to authorize the publication.

P.B.

After a brief introduction:

M. Joliot-Curie. -- One can class the sources of energy in two categories: the one which requires the first material taken from the ground: carbon, petroleum, uranium, thorium; and those which do not require of it as waterfalls and all those which have their immediate origin in the energy of solar radiations which strike the terrestrial crust. They are sources of great interest since they will last as long as there will be sun and water. And one can foresee from now on--they are rather imprecise calculations, that there will be enough water on the earth for 5,000 to 10,000 billions of years.

Before these 5,000 or 10,000 billions of years, one will know how to propel rockets capable of reaching some planets which are presently too close to the sun and uninhabitable, but which, later, will become inhabitable. If it becomes then necessary to reach planets more distant still, planets of other stars than the sun, it will be perhaps necessary to have some couples leave

in order to have children en route. At least to have human life prolonged in considerable proportions, the parents will not arrive, but their children will arrive.

There is there a lesson that we find again in science and in all human activities: let us not undertake tasks of which we cannot necessarily see the completion? But we work when even with enthusiasm, thinking that the successors will profit from it.

In my opinion, one must busy himself very seriously, and from now on, with the utilization of solar energy. It is no doubt by technical investigations that one will come to improve considerably the procedures of utilization of the energy of solar radiation. It is, I repeat it, a problem of very great importance, which must interest French industry and the establishments of applied research in the state. In brief, it is convenient to make appeal to all the sources of energy possible and to conduct simultaneously the researches in view of causing to shoot forth new ones. It would not be reasonable to see in atomic energy the only source capable of answering the considerable extension of the needs in energy of our country.

We have here to preoccupy ourselves with atomic energy and the possibilites of developing this type of sources.

Let us envisage first of all the question of the net cost of the kilowatt-hour. We have hear, no doubt, some specialists tell you: "It is more expensive than the thermal kilowatt-hour or more expensive than the hydroelectric kilowatt-hour." Certainly, it is somewhat more expensive today: but in the field which

is evolving so rapidly, one is right in thinking that in one, in two years, it can pass plainly below. But what it is necessary for us: it is energy; it is not so much a question of cost, but particularly a question of hours of work necessary in order to build and to perfect these sources, a question of possibility of mineral resources, of possibility of equipment.

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I remember often that here even, in conference, at the moment when we put Zoe in operation, in 1948, I had recalled the emotion that we had felt when Zoe began to function. We foresaw at the time that with 20 power stations of 200 to 300 kwh each, one would produce as much electricity as we were consuming in France; and that the required fuel annually to maintain these 20 power stations could be transported by a single truck of merchandise. It is necessary to have enter the net cost of the kilowatt-hour numerous factors as the latter.

(Mr. Joliot-Curie then examines the positions of France and other countries in that which concerns uranium ores.)

I beg you to pardon me for exposing in this long preamble a certain number of considerations which seemed to you no doubt too general, instead of answering directly the problems that you were asking me to examine.

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The problems that you have posed, make appear how you are already well-informed on these questions: the fitting out of the different industries which participate in the atomic installations, the problem of the formation of plans, the role of the

State and industrial cooperation, the problem of research, the protection of the personnel, etc... I will add to it the problem of resources of first materials and those of the guarantees of outlets and patents. All these problems are joined among those, and to be better in proportion to examining them, be in particular, be in their category, there is advantage in knowing the two following aspects which they offer themselves in first approximation: on the one hand, the laboratory aspect of basic and technical research, and on the other hand the mineral industry aspect, the industry of elaboration of the raw materials, the industry of construction of the appropriate power stations.

(Mr. Joliot-Curie then recalls the story of the discoveries of fission and of the creation of the Commissioner's Office in Atomic Energy.)

Despite all these difficulties, thanks to the conjugated efforts of scientists, technicians, and administrative officials of all leanings (of diverse political opinions), and of French industry, the first French pile Zoe was put in functioning December 15, 1948. One knows which repercussions this realization had in the world for the prestige of our country; the world press of the period is there to attest it. One knows then how the program established since 1946 is being realized with success by the construction of a second pile P^2 and of the first power station of Marcoules. I thought useful to retrace briefly the conditions, the state of mind which was prevailing at the time of this first stage.

It is enlightening on this subject to read the first report on the activity of the Commissioner's Office in Atomic Energy

of January 31, 1946, to December 31, 1950. You will find there, gentlemen, valuable information for the future, at the time when one can speak of a new stage in the development of atomic energy: the one of the construction of the large power stations. This report, gathered with a rather large number of copies, was parsimoniously distributed after the successors had affixed on the cover, at the last moment, in gray tampion, the insciption "Confidential." Now I saw nothing in this report that there was of interest to hide. I dare believe only that the editors have simply wished to conceal the efforts and the basic realizations of the pioneers.

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Always is it--it seems to me--that the members of this Commission could reclaim this brochure at the present administrator general of the Commissioner's Office in Atomic Energy.

(Mr. Joliot-Curie takes in his hands the brochure and shows the title of it to the President of the Commission who observes it.)

You will find in it notably:

1) The relations with industry for the preparation or the acquisition of raw materials: uranium oxide, heavy water, very pure graphite, etc... and for the construction of various buildings and machines;

2) The organization at the heart of the Commissioner's Office in Atomic Energy of the direction of investigations and mineral exploitations and the first and important discoveries of uranium deposits in France;

3) Technical research in the establishment and the financial aid brought to the external laboratories of universal character for the development of basic research;

4) The formation of plans;

5) The protection of the personnel, the (legislative or government) bills regulating the use of artificial radioelements in France because of the noxious effects of the radiations of libing beings.

6) The recruiting of personnel and the financial data.

Thery are well there the first solution brought then to the problems which preoccupy you at present. The pioneers were dispersed from the Commissioner's Office in Atomic Energy ought to rejoice to see being continued for the good of the country the work undertaken. (He regrets nevertheless that the measures that have affected them have been able to provoke some delays in the realizations.) I have had myself the pleasure of being able to visit, several months ago, after six years of estrangement, the Center of Nuclear Studies of Saclay. I have seen researchers preparing an abundant material hard at work in the beautiful buildings whose plans I knew well. But I knew that there are many efforts to accomplish between the establishment of plans and the concrete realizations, and it is a great merit to have build well for those who have succeeded us. We have known the most difficult period, the one in which one leaves almost naught, in a country which raises itself laboriously from the ruins of war.

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Establishing myself on the conviction that French industrial material potential is sufficient in order to undertake with confidence the efforts that the crossing of the second stage necessitates, I maintain to emphasize strongly that success will depend essentially of the state of mind and of the deportment of all those who, in the public sector and the private sector, have responsibilities in this business and, in the first place, of those who, appointed by the government, have charge of administering and directing the establishment of State that the Commissioner's Office in Atomic Energy is. Their deportment must be first of all to endow their Homeland with the sources of atomic energy indispensable to a substantial development of the well-being of their fellow-countrymen. No paltry consideration of origin of Schools, or interests and selfish profits of particular common ownerships, industrial or others, must influence the decisions if we want, as that is indispensable, to realize the full use of French resources in men and material. This establishment, receiving its funds from the State, must be managed as would be an industrial firm which has accounts to give to its shareholders, a firm which ought to bring them revenue, which ought not to become bankrupt. It does not suffice to have a compatability in leadership, satisfying for the financial controls of the State, it is necessary that results of all kinds, being able to be conveyed as benefits, be brought to the community. In brief, this establishment must be managed as a firm whose shareholders be the tax-payers, shareholders to whom it is

necessary to bring substantial profits without anxiety of becoming bankrupt. This conception moreover ought to be the one of all directing establishments which exist from the subsidies of the State. Among these directors are representatives of the Corps of State, former students of the polytechnical school. I do not think that the education that they have received, and the traditions which have been established, be in a general way favorable to the success of undertakins, and particularly of the one which here interests me. Certainly there are exceptions and the list of honors of technicians, great servants of the State, departed from this School is glorious. It is especially glorious if one goes back to the history of the technical and industrial development at the time of the nineteenth century. But one must recognize that it is much less in this first part of our century. This is so much more regrettable that this great School recruits no doubt the most endowed elements of the youth of the high schools. General education dispensed at the School is not bad, nor that of the Applied Schools, but the practice with concrete problems to solve is not considered with enough care and situations of leadership are entrusted to young people who are not themselves knocking against actual difficulties, against the unreasonable demands of production, against the dangers of bankruptcy and who ignore, often because of their social origin, important human problems. There results from it a kind of sclerosis having unfortunate repercussions on national production. Important reforms assert themselves concerning the education and the recruiting of the Corps of State. We would wish that the polytechnical

school render again as great services as she has formerly rendered. But I allude already there to the problem of the education of the staffs.

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The importance of industrial equipment required in order to realize the program, of which no doubt Mr. Francis Perrin spoke to you at the occasion of his lecture, is in my opinion by measure of the French industrial potential. Certainly a great effort is to attempt, but it is possible. It is sufficient to compare the investments, materials, equipment, technical and worker personnel necessary in order to realize the atomic energy program with those who constitute the armament effort in time of peace, and have fortified in case of conflict as the recent one in Indochina, and at present in Algeria. The effort to agree on the atomic energy program is a fraction little higher of this last (one) and I will allow myself to add more profit-earning for the whole of the countries. The necessary industrial equipment does not alone concern the large chemical, metallurgic, mechanical industry, but also the industry of construction of various apparatus, apparatus of control, of detection of radiation, generators of transmuting projectiles, separators of isotopes, etc... It is a question of the establishment of an industry of medium importance, founded notably on the application of electronics. Already several firms of this type have been established and begin to construct a material suitable and even exportable.

This aspect of the problem of industrial equipping is not alarming, it can in addition, as the one of large industry, corresponding to it outlets abroad. This question of the possibilities of exportation seems to me important and concerns the question of guarantees given by patents.

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The inventors have abandoned all their rights to the State. One of the patents has then been disposed again in common with Great Britain. I ignore which is the type of these patents at present, if it is no doubt an indiscretion of the American press who have talked about indemnity to pour out to the inventors, no doubt because the services for examination of the American patents have not wished to recognize our patents. How has the French position been protected in this matter? I ignore it. I hope that new patents have been disposed since 1950. There is information to obtain, which ought to interest the Economic Council.

In this first part, I want to have appear that the problem of industrial equipping was not in my opinion the most difficult to solve. It ought not alarm us with the condition that those who have a high responsibility in the mission which is entrusted to them show proof of the state of mind that I have managed to characterize. They will know how then to create the enthusiasm necessary in the success of the quarters of all those who, at all levels, whether they be of the public sector or of the private sector are devoted in this work of national interest.

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I come to the problem of the education of the staffs, and it is there that one must take care not to commit errors under penalty of compromising all.

In the present state of national industry, we can realize very quickly great things if the country makes ready enough men competent and determined to succeed. It is common place, but very true, to say that it is necessary first of all to build in men before building in stones. I like this statement to evoke the image of the plantations of trees which, stopping the streaming of water, prevent the cultivated ground from being carried away. Some time is necessary in order that a young planted tree play this role and science cannot until then have the trees grow more rapidly. The following instructive anecdote comes back to me: Lyautey, on a tour of inspection in Morocco, in front of a distressing spectacle of a valley ravaged by running water, asked the Officer of Waters and Forests who was accompanying him what it would be suitable to do in order to render these lands cultivatable. The officer replied to him: "To plant forests on the hills and these lands would become of an extreme fertility."

--How long would it be necessary in order that it be so?

--Fifty years, said the officer.

--Then, start tomorrow, replied Lyautey.

There was a noble lesson. The more the task required time in order to be accomplished, the less one must wait in order to begin. It is therefore immediately that it is necessary to make the arrangements in order to increase the number of men capable

of developing atomic energy, as well in the industrial domain as in the one of basic scientific investigations. The education necessary requires more time than the construction of a reactor.

The education of engineers and of personnel of all kinds, connected with the constructions of reactors and the production of atomic energy, can easily enough be undertaken in the framework of the schools of engineers and of the professional schools, by the creation of specialized sections completing the general education that they dispense. The creation of a national institute specialized in this domain seems to me a good initiative, on the condition to state very precisely that it is a question of the education of technicians specialized in the areas concerning the realizations of the sources of energy of nuclear origin. Such an institute would call for with advantage, in more of a simple education, sections of chemistry, electrotechniques, electronics, application of the artificial radioelements, and practice of protection against the dangers of radiations.

I fear, after the information that I have been able to obtain on this national institute, that its mission be defined in a way too vague, leaving to understand notably that it could be there also operated with the basic education of nuclear physics. There would be a troublesome initiative which would tend to create teaching substituting itself to those who depend on the Faculties of Sciences and the great establishments, with the guarantees and the traditions (and there are of them valuable things as the one of independence in front of the changing of political orientation of governments), that these organizations

bring. There is therefore place for being vigilant as to the precision and the limits to bring to the mission of such an institute whose creation has just been examined by the Superior Council of National Education.

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I will take hold in that which follows in the problem of specialists in the domain of research, so much of the point of view of basic research than of the one of technical research.