Amidst the strategic raw materials of the world, rubber has played a major role in the press during the last few months, as a radical change in ownership has taken place in the sphere of its production. Until a few months ago almost all natural rubber came from territories either belonging outright to the Allies or controlled by them politically and economically. Today the most important areas of production are in the hands of Japan, and the greatest synthetic production is in Germany and Italy, so that almost all raw rubber produced in 1942 is at the disposal of the Axis powers. Particularly in the United States the restrictions in rubber consumption are being tightened from month to month, and within six months only a fraction of her once vast fleet of automobiles will move along her concrete highways.

The following pages give information on a number of things not generally known to people who have not specially studied the question of rubber production. This information is given, not in the form of a section from the encyclopedia, but through the lively medium of letters written to his family by a Swiss chemist on a rubber plantation in Sumatra.

Although the accompanying photographs were taken in Ceylon and not in Sumatra, we feel sure that they will aid our readers in visualizing the process of rubber production.—K.M.

Timoekan, Sumatra, April 7.

My dear Alfred,

It is three months now since we sat together in front of the ski hut, looking at the snow-covered mountains around us, and my voyage to the Dutch East Indies seemed just as far off as the heat and glowing colors of summer in the midst of the cold whiteness of our Swiss mountains. Meanwhile spring has come to you at home, the meadows are covered with crocuses, the south wind is sweeping through the forests, and for me Sumatra, which seemed so far and full of magic to us when we were boys, now means reality and work.

I have been here scarcely a month, but I have already become quite accustomed to being the youngest assistant at the Timoekan rubber plantation. Two weeks ago I had my first turn at attacking the mighty jungle with my coolies. They cut down the old tree-giants with an amazing speed, and in no time there lay a new clearing, bare and deserted in the glare of the sun. Soon the stumps and roots will be removed and irrigation ditches dug to rid the soil of acids; and within a year brown coolies will be bending hour after hour to plant the tender rubber shoots.

Thus a new plantation will have been born under my supervision at the edge of the jungle, where till recently panthers moved stealthily through the undergrowth. Soon the bare earth will be covered by green weeds purposely planted to provide the roots with the necessary nitrogen. And gradually the rubber forest will grow, reminding me in its delicate green of the beech woods of our own valley at home. Six years from now the new section is to be ready for inclusion in the working process for which it was planted. For that is the
time it takes for a tree to produce good rubber. So if ever I should start my own rubber plantation, I would have to invest a lot of work and money for six years before I could sell my first pound of rubber.

While I am writing this, I am sitting on the screened verandah of my bungalow. After the heat of the day it has turned pleasantly cool. In front of the coolies' huts (pondoks, as they are called here) the little red oil-lamps are flickering, and the brightly lit houses of the other assistants and the administrator shine through the bushes of bougainvillea and canna lilies. Only the factory stands black and silent at the end of the broad white path.

But I don't have many lonely evenings. There is a lively social life in our little rubber state, and a siinkeh, as newcomers are termed here, not only quickly enough learns the fixed rules according to which the work is carried on but is soon caught up in the stream of life outside of working hours. The necessary scraps of Malay are easily picked up. Besides, a lot of English is spoken. Our chief administrator isn't Dutch but English. This is nothing out of the way as forty per cent of the capital invested in the Dutch East Indian rubber industry is British.

I am well satisfied with my salary. Life here is on a scale of luxury that often surprises me. Since the tremendous boom in the automobile industry all over the world, the rubber plantations have been making money hand over fist. The depression years of 1931/32, when many of our sections too lay idle, when coolies were laid off and only the best trees were tapped, seem far off in the dim past. As soon as the demand increased after the depression, production could rapidly be expanded again, for the rubber trees are not like cows that must be milked regularly. They actually benefit from being left alone, with the proviso, of course, that they are protected against disease and white ants and that the ground is kept clear, which can be done with a skeleton force of coolies. Only those plantations which were neglected were soon reconquered by the jungle.

What did I know about Sumatra's rubber last summer, when I stood on the dusty road to Bern, looking in disgust at my motorcycle and wondering whether I should repair the tire myself or push the machine for hours to the next garage? One remembers that sort of thing when one watches the rubber sap as it drips, thick and white, out of the bark of the tree into the little cup.

Tell Mother she needn't worry about me. My bungalow is cool and airy. I am taking every precaution against malaria, and Ali, my boy, looks after me well. Sinah rules in the kitchen. If her imagination were as vivid as the words which seem to flow from her in an unending stream, it might occur to her to cook something else for me besides the everlasting rice and chicken or chicken and rice.

It is late now. I hope to hear from you soon.

Your affectionate brother

Tony

P.S.—I am enclosing two clippings from a trade paper containing figures on rubber consumption and prices as illustrations to what I said in my letter.

CHIEF CONSUMERS OF RUBBER AND THEIR CONSUMPTION IN METRIC TONS (1910 to 1938)

<table>
<thead>
<tr>
<th>Country</th>
<th>1910</th>
<th>1920</th>
<th>1925</th>
<th>1930</th>
<th>1935</th>
<th>1938</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>32,000</td>
<td>240,000</td>
<td>360,000</td>
<td>370,000</td>
<td>450,000</td>
<td>410,000</td>
</tr>
<tr>
<td>Germany</td>
<td>14,000</td>
<td>19,000</td>
<td>34,000</td>
<td>45,000</td>
<td>60,000</td>
<td>104,000</td>
</tr>
<tr>
<td>U.K.</td>
<td>18,000</td>
<td>25,000</td>
<td>31,000</td>
<td>70,000</td>
<td>90,000</td>
<td>28,000</td>
</tr>
<tr>
<td>Japan</td>
<td>700</td>
<td>6,000</td>
<td>12,000</td>
<td>30,000</td>
<td>50,000</td>
<td>60,000</td>
</tr>
<tr>
<td>France</td>
<td>3,500</td>
<td>15,000</td>
<td>35,000</td>
<td>70,000</td>
<td>54,000</td>
<td>28,000</td>
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<tr>
<td>Russia</td>
<td>7,000</td>
<td>1,000</td>
<td>6,000</td>
<td>15,000</td>
<td>40,000</td>
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</tr>
<tr>
<td>Canada</td>
<td>1,000</td>
<td>3,000</td>
<td>20,000</td>
<td>25,000</td>
<td>30,000</td>
<td>31,000</td>
</tr>
<tr>
<td>Italy</td>
<td>1,000</td>
<td>6,000</td>
<td>10,000</td>
<td>15,000</td>
<td>25,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Countries</td>
<td>12,500</td>
<td>21,000</td>
<td>45,000</td>
<td>77,000</td>
<td>102,000</td>
<td>82,000</td>
</tr>
<tr>
<td>The World</td>
<td>90,000</td>
<td>330,000</td>
<td>583,000</td>
<td>720,000</td>
<td>945,000</td>
<td>920,000</td>
</tr>
</tbody>
</table>

Dear Mother,

Today you shall have the long-promised letter about my day's routine. You will smile incredulously when your lie-a-bed son tells you that his day starts at 4.30

Timoekan, August 18.
every morning! I begin by pouring buckets of cold water over myself, and at 5 o'clock, when the sound of the wooden drum booms through the morning, I go to work with my coolies. "Go to work" is hardly an adequate expression—we run to work here. And it is a queer sight to watch the tall figures of the coolies, each with an oil-lamp tied to his head, hurrying through the gray morning light like huge glowworms and disappearing into the rubber forest. This haste with which the Malays, otherwise so slow, run through the sections to attack each tree with their lmivas before the heat sets in has its reason. For the dimmer the light and the lower the temperature, the better does the sap flow. Each of the brown fellows has to tap about 400 trees every day, and the little troop under my command numbers 30 heads.

During the first few weeks I was here I did little else but go through the various sections with the mandoers, the overseers of the coolies. I saw nothing but tapping, weeding, tapping, weeding. In one of our sections there are some trees which are almost twenty-five years old. This is about the greatest age that can be expected here from a rubber tree with good treatment. The average age is usually somewhere between fifteen and twenty years. Four coolies can just span the mighty trunks of our old giants, which still produce their normal average of a quarter of a pint of latex per day. I learnt very soon that a rubber forest must be nursed along, protected from sickness, and trained with an expert hand, like a racehorse. Today I can curse in my own section like a veteran when the coolies cut too deep into the young trees or don't make the cut in the proper direction when they make the fresh incisions every day. Mistakes like that mean about a fifteen-per-cent loss of rubber sap for every tree, and that tots up.

Like most of my colleagues, I have trouble with my mandoer. He is very quick with his knife and is more interested in the wives of the coolies than in my trees. At 9 o'clock, when the tom-tom of the drum announces the end of the morning tapping and the coolies squat down for a rest, he disappears in the direction of the native pondoks. He doesn't come back till the coolies return with their tin buckets from the section where they have been collecting sap from the cups which had meanwhile filled up. I don't know how long the coolies will look on at the activities of this fellow. The usual ending to these affairs is a knife-stabbing, for which I would be held responsible. I think I shall have to fire him.

The day goes on. In the factory every bucket of sap brought in by the coolies is weighed and the rubber content of the "milk" ascertained with the "lactometer." Then the sap flows into large glazed cement troughs, where, with the aid of formic or acetic acid, it is curdled into a soft white cake.

In the next room of the factory the cake of rubber is spread on great cylinders and rollers, as thinly, transparently, and free of holes as possible, just like you do with your famous noodle dough. Then the sheets of rubber are hung up in drying or smoke-houses, later on to be sorted, pressed, and packed for shipping. This is the way the noodle dough turns into finished rubber.
In the afternoon I usually look into accounts and statistics. The other day I supervised pay day for the first time. The coolies were lined up in two long rows, the free workmen to the right and the contract coolies to the left. They slowly filed into the little room where the large cash box stood on a table next to the clerk, who carefully entered every amount paid in neat round figures into his big book.

The majority of our laborers are contract coolies, for whom one has to pay 100 guilders per head at the Labor Supply Bureau. They receive much lower wages than the free workmen, whose pay runs from 6 to 35 guilders according to conditions. But the Labor Administration, known as the Kuli-Ordonantie, protects the contract coolies through social legislation, while it enables us employers to engage reliable workmen for periods of three years. This is an important consideration, what with Sumatra’s sparse population and the difficulty of obtaining good labor.

In bad times it is mainly the free workmen who suffer from retrenchments or closing down. And they do suffer considerably, as, in contrast to the other islands of the archipelago, the native culture of rice is hardly of any moment at all here as a source of livelihood. You see, with the majority of the population being employed on plantations at fairly good wages, it is much cheaper, in normal times, to buy imported rice. So there was no inducement to plant rice on a large scale. Besides, the plantations themselves do not exactly favor too much ground being converted into rice fields, as this crop exploits the soil and would be disadvantageous for the possible future expansion of the plantations. This is why a depression on the rubber market usually leads to labor emigration from Sumatra.

But enough of all this. This evening I have been invited to dinner at the Administrator’s. He is very easy to get along with, especially since we had a few drinks at the Planters’ Club and I could prove that the sinta was not to be drunk under the table. At bridge, too, I have been able to hold my own so far.

I wonder how you all are? I hope the next plane brings mail. You needn’t worry about me. I am well taken care of. Often I have to laugh at my boy Ali. You would scarcely appreciate his method of blowing his nose in my presence with the aid only of his long brown fingers. But what did this chap say to me when I remonstrated with him the other day? “Tuan besar (that’s what white men are called here: it means “great master”), my way of blowing my nose is much better than yours. You and the other tuans use a piece of stuff which you fold up afterwards and carry around in your pocket all day. I do it like this (followed a demonstration) and don’t dirty up a nice white piece of stuff.” Well, perhaps Ali isn’t so wrong after all! You see the kind of worries I have.

Your loving son
T Tony

Timoekan, January 11.

Dear Peter,

Yesterday, when I returned from the port of Medan, I received your long letter with all its questions. Well, you don’t seem to have changed at all. You are still exactly like you were when we used
to walk along the lake and you hardly gave me a chance to reply to all your questions. So I sat down immediately to answer your letter, as I happen to have some free time on my hands at the moment.

You see, every other month no tapping is done in my section in order to give the trees a rest, and I sometimes make use of this opportunity to take a short holiday and go to Medan. You couldn't really call it a holiday, for I spend most of my time there at the wharf where our cases of rubber are being shipped to Singapore and I take care of all the necessary formalities with the shipping company. Still, I usually have plenty of time left in Medan for tennis, the swimming pool and, in the evening, the cinema.

Meanwhile you have been moved up into the next grade and you write enthusiastically about your new history teacher. So he is telling you about Columbus and his discoveries! Well, I can tell you something today about this gentleman that I am sure you haven't learnt in history class. If I hadn't become such a bookworm during the rainy season I wouldn't know myself that it was Columbus who, on his second voyage of discovery in 1495, first saw, in the hands of natives of the island which today is called Haiti, that supple resin known now to the world as rubber. At that time the Haitians were happily playing with dark, elastic balls whose bouncings Columbus and his companions watched with amazement. Besides this, there was a kind of material which, coated with a milky liquid, was as shiny and as waterproof as the oilcloth we have today. Probably Columbus also took along one of those bottles made by coating an earthenware form with the same solution, which became tough and supple; then the earthenware form was broken up and taken out through the neck, and the bottles could be used to keep all kinds of liquids.

How about telling your teacher about this meeting between Columbus and rubber? And if he should say that this is a rather doubtful story, you can tell him that he can look it all up in the works of the Spanish historian Antonio de Herrera. I am sure he will give you good marks for this. Or do you still have the same old idea: Better to have bad marks than to be considered teacher's pet?

There, I must stop now. I am expecting guests this evening and I must keep an eye on "cokki" and Ali. Otherwise something is bound to happen like last time. We were having roast sucking pig, and I had told Ali to serve it with a lemon in the mouth. And what happened? When Ali solemnly served up the crisp roast, he had a piece of lemon in his own mouth. You can imagine how my guests laughed! So this time I shall look after things myself.

Good-by for the present. Write soon.
Your affectionate uncle,

Tony

Dear Father,

Enclosed I am sending you my notes, maps, and diagrams for a lecture on rubber I gave last week to a high-school class. This lecture almost didn't take place at all, for, just as I was ready to drive there, I suddenly discovered that my watch had been stolen. I had to wait an hour and a half for the police, who refused to appear immediately
because they happened to be at the movies, which are shown once a month in the neighboring village. And as stealing is an everyday affair here, while movies are something special, I just had to wait.

I am glad to hear that you are all well. Give my love to Mother and the rest of the family.

Yours affectionately,

Tony

NOTES FOR LECTURE

Today a belt of rubber encircles the tropical part of our globe. It reaches from Liberia, Nigeria, the Cameroons, the Congo, over Ceylon, through the Malay States into Thailand and Indo-China, and goes on via the Dutch East Indies to Mexico and Brazil. The table here on the wall gives an exact survey of the rubber production of the various areas.

Until about seventy years ago *Hevea brasiliensis*, found exclusively in Brazil, was the only one among the many dozens of plants of the rubber group which could be used for the rational production of rubber, as it yielded by far the best raw product, in quantity as well as in quality. In those days rubber was practically a Brazilian monopoly.

At first articles made of rubber turned out to be useless. Heat would melt them, and in low temperatures their brittleness caused great difficulties. But in 1839, after years of experimenting, an American, Goodyear by name, discovered a process known as vulcanization, through which, by chemical means, the strength, hardness, and elasticity of rubber under any temperature could be vastly improved.

The possibility thus created of technically utilizing rubber caused Brazil to cling even more stubbornly to her monopoly. At that time one could hardly speak of proper plantations. There was nothing but "wild rubber," as it is called. Because of careless methods of tapping, the trees threatened to disappear with terrifying rapidity, while on the other hand the Brazilian Government took widespread measures to prevent the export of the precious seeds of these trees and to retain the monopoly for Brazil. However, it had no luck with these measures. In 1876 the British planter Henry Wickham succeeded in smuggling seeds of *Hevea brasiliensis* out of Brazil. In the hothouses of London's Kew Gardens, these seeds grew into little plants, which in turn were shipped in 1882 to Ceylon, Singapore, Calcutta, Buitenzorg, and Surabaya, forming the original basis for our plantation too. The resulting relocation in rubber production within the last thirty years is shown by this diagram (see p. 35).

In modern factories, among all the boom in the automobile industry, quickly made rubber one of the most important raw materials in world economics. As was to be expected, science began to study the question of whether the same material could not be produced chemically. The struggle for the synthesis began, for a product as close as possible to natural rubber which could be manufactured in the retort independently of the tropical sun.

Every synthesis is based on the exact knowledge of the chemical structure of a material. If we look through the microscope at a drop of rubber sap or latex, as it is called, diluted with water, we see tiny particles moving around at great speed. These are the rubber particles, so small that one pint of latex contains 400,000 billion such particles. Besides rubber and living bacteria, latex also contains a large number of chemical substances, about fifty of which are known. Apart from traces of ash and sugar, the most important are mixtures of resins and albumen.

Artificial rubber is manufactured today in various parts of the world, mainly in Germany. And the paths followed by chemistry are many and varied. The discoveries of Williams, Bouchardat, and Fritz Hofmann, who at the turn of the century found the basic substance through isopren and butadiene and thus the first step towards the synthesis, have been made use of in this connection. In German chemical circles the word "Buna" (bu-ta diene and acrylim) first appeared in 1928. It was then, however, still a matter of groping and experimenting. But when, in the spring of 1936, tires made of Buna were shown at the Berlin Motor Show, it was no longer a question of a chemical miracle but of a finished industrial product which had stood the most severe tearing tests.

We must not be misled by the fact that we are living in a country of natural rubber to dismiss the chemical manufacture of rubber with a shrug of the shoulders. This table will show you the qualities of Buna.

<table>
<thead>
<tr>
<th>Kind</th>
<th>Characteristics of Buna Products Compared with Natural Rubber</th>
<th>Elongation at Breaking Point</th>
<th>Hardness</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Rubber</td>
<td>Surpassed by Buna in individual characteristics only, not as a whole</td>
<td>260</td>
<td>600</td>
<td>65</td>
</tr>
<tr>
<td>Buna A (Buna N)</td>
<td>More resistant to gasoline, oil, and ozone, 25% less wear, 50% less permeable to gas, 20% more heat conductivity</td>
<td>300</td>
<td>600</td>
<td>70</td>
</tr>
<tr>
<td>Buna B</td>
<td>More resistant to heat and ozone, Up to 20% less wear. (Rubber for tires)</td>
<td>250</td>
<td>650</td>
<td>65</td>
</tr>
</tbody>
</table>

You might be interested in a short description of the present manufacturing process of Buna in Germany. Coal and lime are placed in huge furnaces, where with the aid of electric current they are turned into carbide. The lava-like stream of carbide then flows into cooling-drums, where it flies apart into little pieces. Now the carbide, finely ground and brought into a plant where it is transformed into acetylene with the aid of water. In seventy-foot cylinders a further transformation takes place and in the end a product is obtained which looks exactly like the latex of our rubber trees. And, just like our rubber sap, this Buna milk is transformed into a flaky cake.

All these processes are conducted automatically, supervised by a few men standing at
Dear Alfred,

This letter must catch the mail plane. It is the last I shall send you from Sumatra. And yet it seems to me as if it were only yesterday that I wrote you the first time from my verandah. These years have passed so quickly. Perhaps it has something to do with the regularity of the days, with the everlasting heat and greenness and quiet that fills this country and its people.

Heavy clouds have gathered on the horizon of the world. I am glad to be able to return home, to the place where each one of us should be in such times as these. I am looking forward to your meeting me at the boat in Genoa. And then we shall go together as fast as we can back home to our mountains.

See you soon!

Yours,

Tony