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GERMAN BREWING INDUSTRY - PART III

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GERMAN HOP GROWING DISTRICTS ANNUAL PRODUCTION TABLES

These figures, which were obtained from a German source, are known to be inaccurate in certain respects.

Hallertau

Hops Year	Area of Cultivation Acres	Crop per Acre. Cwts	Crop of the Whole Area Cwts
1933	12,664	11.3	118,343
1934	11,283	6.0	68,100
1935	12,464	12.1	139,555
1936	13,361	10.1	126,083
1937	11,614	10.8	126,074
1938	11,441	10.8	124,024
1939	11,357	11.9	139,968
1940	9,598	13.4	128,754
1941	9,598	10.2	98,283
1942	8,525	10.5	89,849
1943	8,649	12.2	105,627

Spalt

Hops Year	Area of Cultivation Acres	Crop per Acre. Cwts	Crop of the Whole Area Cwts
1933	3,272	3.6	10,467
1934	2,481	6.1	15,277
1935	2,701	6.3	15,666
1936	2,938	7.7	20,829
1937	2,614	6.9	17,909
1938	2,444	8.2	19,965
1939	2,338	9.9	23,140
1940	2,048	8.2	16,656
1941	2,048	6.9	14,140
1942	1,700	8.0	13,691
1943	1,606	7.5	12,057

Rheinpfalz

1933	-	-	-
1934	133	7.7	1,031
1935	141	15.1	2,023
1936	153	10.1	1,421
1937	151	14.3	2,157
1938	151	12.1	1,819
1939	151	24	362
1940	146	26	362
1941	146	39	563
1942	69	7.0	484
1943	69	8.8	610

Tettnang u. bad. Bodensee

1933	-	-	-
1934	1,357	8.8	17,853
1935	1,611	16.3	19,281
1936	1,611	12.3	19,834
1937	1,633	15.3	25,060
1938	1,648	11.9	19,979
1939	1,648	13.5	22,476
1940	1,310	15.1	19,722
1941	1,310	10.7	14,051
1942	1,317	13.0	17,073
1943	1,273	8.4	10,712

Hops Year	Herebruck Area of cultivatiom Acres	Crop per Acre Cwts	Crop of the Whole Area Cwts	Hops Year	Baden Area of cultivatiom Acres	Crop per Acre Cwts	Crop of the Whole Area Cwts
1933	2,617	3.9	8,358	1933	694	6.5	4,035
1934	2,441	7.2	17,785	1934	620	5.7	3,575
1935	2,755	5.8	14,885	1935	573	7.8	4,767
1936	3,239	3.0	8,278	1936	734	8.0	4,584
1937	2,580	6.9	17,751	1937	692	6.5	4,495
1938	2,328	6.3	14,754	1938	544	8.6	4,676
1939	1,989	9.8	19,583	1939	440	9.3	4,077
1940	1,779	7.5	13,299	1940	383	7.1	2,729
1941	1,779	2.6	4,665	1941	383	2.3	889
1942	927	7.2	6,656	1942	77	8.2	626
1943	902	8.4	7,560	1943	69	6.6	459
	Rottenburg Weilderstadt				**Aischgrund**		
1933	-	-	-	1933	403	0.9	269
1934	1,226	8.6	10,496	1934	324	3.5	1,136
1935	1,292	10.9	13,395	1935	366	4.1	1,390
1936	1,433	6.7	8,748	1936	410	1.6	611
1937	1,342	9.4	12,570	1937	304	3.5	1,065
1938	1,285	6.9	8,889	1938	200	2.7	545
1939	1,273	8.0	10,127	1939	170	2.5	423
1940	1,075	8.3	8,960	1940	173	2.4	405
1941	1,075	4.7	5,031	1941	138	0.5	74
1942	618	8.2	5,051	1942	-	-	-
1943	568	7.9	4,487	1943	-	-	-
	Jura				**Preussen-Grenzhausen**		
1933	193	3.1	484	1933	37	8.5	272
1934	153	9.2	730	1934	27	8.4	228
1935	193	8.6	1,337	1935	67	10.5	145
1936	301	5.7	1,106	1936	67	8.0	180
1937	252	9.2	2,303	1937	15	9.5	141
1938	240	6.8	1,634	1938	15	9.2	137
1939	208	8.5	1,763	1939	10	9.4	93
1940	138	10.1	1,402	1940	5	11.6	57
1941	173	5.2	903	1941	5	2.2	11
1942	111	7.7	859	1942	-	-	-
1943	111	8.4	931	1943	-	-	-

H. O. A. G.

Hopfenhandels-Aktiengesellechaft Nachf.
Gaensbauer & Co.

Nurnberg, July, 1946.
Krelingstrasse. 37.

Translation of a German Trade Publication setting out the Economic Position of the German Hop Trade

Following the occupation of Germany by the Allied Military Forces, the hop growing areas which had previously been under the German economic sphere of influence, were, to a considerable extent, parted therefrom. Saaz, Auscha, and Dauba returned to Czechoslovakia. The Alsatian districts returned to France. The areas on German soil in Bavaria - Hallertau, Spalt, Hersbruckergebirge and Kindinger Land - came into the U.S.A. Zone; the Wurttemberg areas - Siegelbezirke, Tettnang, Rottenburg-Herrenberg-Weilderstadt - into the French Zone; and the Baden areas also into the U.S.A. Zone.

At the end of the war, considerable bulks of the 1944 crop were still in store in the growing areas. It had not been possible to despatch them to the buyers owing to the ever increasing transport difficulties caused by the war. Hops stored in those areas reverting to Czeckoslovakia were confiscated by that State as repayment in kind. Those in store in the U.S.A. and French Zones were likewise confiscated by the occupying powers. The same occurred with the whole of the 1945 crop in both Zones with the object of offsetting their value as part payment for the considerable quantities of foodstuffs imported into the two Zones during the past months. Meantime, disposal instructions had been issued for the bulk of the 1945 crop. In the French Zone the residue of the 1944 crop and all of the 1945 crop were taken over by the Military Authorities. Fourteen thousand hundredweights (14,000 cwts) of Bavarian Hops were exported to the British Zone from the U.S.A. Zone and the balance of the 1944 crop plus a certain quantity of the 1945 crop, was allocated to breweries in the U.S.A. Zone, in accordance with their requirements till such time as the next crop became available. However, by far the greater proportion of the 1945 crop had been or will be, exported. By the time that further anticipated exports have been completed, some 80% of the 1945 crop will have been disposed of. No opinion could be expressed at the moment as to whether or not the balance will also be exported.

1945 Crops.

Hallertau	55,000 cwts.
Spalt	8,000 cwts.
Hersbrucker-gebirge and Jura	3,000 cwts.
Total Bavaria	66,000 cwts.
Tettnang	6,000 cwts.
Rottenburg Herrenberg-Weilderstadt	3,000 cwts.
Total Aurttemburg	9,000 cwts.
Grand Total	75,000 cwts.

This crop was not much below the average of the previous years although grown in the last year of the war. Since the cessation of hostilities great difficulties have been experienced in all Zones in the supply of hops to German breweries. These difficulties had been felt to the greatest extent in the Russian Zone on account of its isolation, and because it had taken practically no share of the already short supplies of hops available. It was not difficult to surmise that such difficulties would arise after the cessation of hostilities. Since 1936 the areas under cultivation had shown progressive decrease, as indicated by the following table:

	German	Sudetenland
1936	10,280 hectares	11,361 hectares
1937	9,218 "	11,385 "
1938	8,472 "	7,400 "
1939	8,070 "	6,437 "
1941	6,740 "	5,470 "
1945	5,600 "	

The first signs of the coming supply difficulties were evident in the last years of the war. In those years the whole crop was taken up in Germany and in those few countries to which it was still possible to export. Even then allocations to the consumers had already been much reduced, and many breweries were compelled to draw on their reserves. The production programme was such that the Sudetenland produced some 50% of the total requirements, assuming that the crop conditions were the same in all areas. The loss of the production from the Sudetenland following cessation of hostilities, amounting to some half of the total bulk available, would obviously magnify the already difficult supply position.

Hop Consumption and Production.

In the meantime, reserves for German breweries had dwindled to a minimum level, and the majority of breweries in the Western Zones were hardly likely to get through till the next crop became available. In the Russian Zone there were now, for all practical purposes, no reserves whatsoever. In 1943 to 1944, hop consumption in the German breweries, and those in the satellite countries, amounted to 143,000 cwts. Through loss of consumers in the East, South-East, and West, reduction in brewing through regulations applying in the various Zones - in some cases complete cessation and damage or destruction of brewing plants - consumption had fallen greatly. On the 1943 to 1944 basis, the consumption in the four Zones will probably be as followse-

U.S.A. Zone	ca. 31,100 cwts.
British Zone	ca. 24,500 cwts.
French Zone	ca. 12,600 cwts.
Russian Zone	ca. 24,000 cwts.
Total	ca. 92,200 cwts.

Consumption in the current year will be appreciably lower for the reasons given above, and on account of the shortage of malt. Breweries in all Zones have had to turn to the production of non-alcoholic beer, in the production of which hops are either not required or only in small quantities. It can hardly be assumed that in view of the anticipated improvement in the general world supply of food, and the elimination of the present shortages of brewing barley, that the present conditions will continue. Again, it is not yet known to what extent the easing of trade barriers between the different Zones and the conclusion of a peace treaty, will influence the total beer production. Even though it was not possible to draw a definite conclusion as to the present and future consumption of hops in Germany, it was nevertheless quite clear that German hop production will be far from sufficient to cover home requirements, and, at the same time, leave a surplus for export. The entire problem was associated with the present rather uncertain future political position of Germany and the general doubtful economic situation. It was certain that in the initial period, after the cessation of the war, German breweries had used up their reserves: that the demand for German quality hops was very great, particularly in those countries whose supplies were cut off during the war, consequently German production will not be sufficient in the future to satisfy an increased demand. Assuming a theoretical figure for the German brewing industry of 70% of the 1943 to 1944 consumption, the demand would be 60,000 cwts. Assuming export trade would be equal to that of 1937 (which, incidentally, would be the same as this year) of 60,000 to 70,000 cwts, we have a total requirement of 120,000 to 130,000 cwts, as compared with a production last year of 75,000 cwts. Even allowing for major adjustments to these figures, it was clear that the present production could not possibly cover current requirements and would be entirely inadequate.

The area under cultivation in Bavaria has been increased by 288 hectares this year, but, as hops require three years to mature and yield a full crop, the full benefit of this additional area would not be observed until the 1948 crop. Apart from the fact that this additional area was far too small to cover the deficit, it must be reckoned that the present supply difficulties will continue for a number of years. Assuming average crops, it will be necessary to increase the area under cultivation by 3,200 hectares to give the minimum required increased production of 50,000 cwts. In view of the general conditions with regard to food production suggestions to increase the area under hop cultivation made immediately after the end of the war raised serious doubts in the minds of the competent authorities. These authorities, whilst admitting the importance attaching to the future recommendations made with regard to the areas under hop cultivation, pointed out that it was essential to permit increases in the cultivation of only potential foods. It may be assumed that due weight was given to the question of preparing any areas required for hops. In the spring of this year there had been a considerable amount of wood-felling to obtain timber for the export market, and the areas so cleared were now available for cultivation. The question must now be raised as to whether or not it would be desirable to transfer certain field crops from land suitable for hop cultivation to those areas cleared by felling, and to utilise the land so released for hops. There appears to be no economic argument that could be brought against this suggestion, since the capital invested in hop cultivation will amortise more rapidly and pay a higher dividend than if invested in afforestation which requires many years to develop. Further, the area required for hops is so small as compared to those areas already afforested that the losses would hardly be noticed. Recent press announcements have indicated that areas under cultivation in Bavaria were to be increased by 248,000 hectares, and devoted to the cultivation of various food crops. It was not known whether hops would be included in this scheme. An increase in German hop production would serve not only to cover the shortages in Germany, but also to assist the hop requirements of other lands where shortages also existed. Hops, with one or two exceptions, were the only agricultural product which the Germans could export in large quantities. Already, hops have taken their place in the German export trade to help to pay for the foodstuffs which were being imported. The significance of an increased hop production to the German export balance was shown in a most interesting and convincing manner in Issue No.5, 1945 "Die Brauwelt". The export of hops grown on one hectare suffices, assuming the same price for home and export trades for both hops and grain, to cover the purchase of as much grain for bread-making as could be grown on eighteen hectares. Assuming general world prices, the factor would be even greater - i.e. fortyfold. This alone shows the significance of increased hop production. The provision of German foodstuffs would necessitate considerable imports in future, and the rehabilitation and maintenance of German industry would also require the importation of many materials, for the payment of which German export trade will have to supply suitable goods. The sooner such barter export goods were available, the sooner would Germany have the benefit of the goods for which they could be exchanged. Considering the three year maturation period of the hop plant, it was essential that the least possible delay should occur in preparing the additional areas required. An adequate supply of hops is as much in the interests of the brewing trade as of the hop merchants, and both should spare no effort to see that this objective was attained as soon as possible.

BARLEY RESEARCH.
HEINE SEED TESTING STATION.

Target: Saatzuchtwirtschaft Ferdinand Heine.
Location: Schnega/Hannover.
Type: Barley Breeding Station.
Date: 17th July, 1946.
Persons Interviewed: Dr. Haarreng - Director.

Dr. Göpp, who had been carrying out experiments with a combine harvester, was not available for interview. The main trend of his investigations had been to ascertain the barleys best suited for this method of harvesting. The combine harvester used was made by Claas in Westphalia. A unit of this make is in the possession of the British Agricultural Engineering Research Station. During the war, the area under barley cultivation had been considerably reduced to permit of an increase in food crops, and in particular potatoes, wheat and vegetables. Reports had been heard - emanating from the Weissheimer Maltings of Andernach - to the effect that the barley acreage was to be doubled so that a surplus would be available for export to France, Belgium and Holland.

Three new barleys were examined and samples taken:

Haisa. A cross between Hanna and Isaria.
Isaria. Bred by Ackermann of Straubing.
Haha. A cross between Hanna and Hadostreng.

Isaria frequently gave a turbid wort and had been found to have insufficient strength in the straw. Haisa was said to give not only the best yield and malting quality, but strength of straw. According to German Government instructions, the main object of their wartime investigations was to obtain barleys giving the highest yields per acre. It had been found that Haha was good in this respect provided that the land was capable of yielding heavy crops. Isaria was said to be very steely and Haha less steely; on the other hand Haisa was a mellow barley:

BARLEY RESEARCH.
THE AGRICULTURAL SCHOOL, HOHENHEIM.

Target:	Hochschule fuer Landwirtschaft.
Location:	Hohenheim/Stuttgart.
Type:	School of Agriculture and Research Station.
Date:	28^{th} July, 1946
Person Interviewed:	Dr. Lakon - Director, Department of Plant Physiology.

Dr. Lakon had published, in 1940, a paper describing a method for staining the dissected embryos of cereals which showed whether the embryos were alive or dead, and further, how far the loss of viability had spread through the embryos. For this purpose the staining agent used was acid sodium selenite. In 1942 further publications were issued describing the use of tetrazolium salts in place of selenite.

As a result of dormancy, a normal germination test did not determine the true germinative capacity of cereals if applied shortly after harvest. It was claimed, however, that the true germinative capacity could be ascertained by means of the staining method.

The selenium method had the disadvantage of being harmful to those handling the selenium owing to the development of poisonous fumes, and furthermore the stain it produced was not sufficiently definite. As a result of the observations of R. Kuhn and D. Jerchel that tetrazolum salts produced an intense red colouration in plant tissue without endangering the life process, Dr. Lakon decided to investigate the effect of these salts on cereals in relation to germinative capacity. It was found that the tetrazolium salt was reduced to a formazone by living tissue, which was in consequence stained to an intense purple-red. As the reduced dye was insoluble there was no diffusion into the surrounding cells and thus it presented an accurate demarcation of the areas of living tissue. The degree of accuracy was demonstrated by Dr. Lakon with a sample of maize which had been stained for some time, and which confirmed that the resultant stain was most stable. The method had the added attraction of being more rapid than the selenium one. As a result of the B.I.O.S. investigations tetrazolium salts are now being produced in the United Kingdom.

Dr. Lakon is at present engaged in pursuing further investigations designed to increase the scope and usefulness of the method. It is understood that some of this work relates to additions designed to improve the staining power of triphenyl tetrazolium chloride and to variations in the technique to embrace an ever-widening variety of seeds.

With barley the germination test by the Lakon method is performed by soaking the barley corns in distilled water for one hour, or better still overnight, care being taken not to exceed 18 hours, and then dissecting out the embryos. One hundred of the dissected embryos are then steeped in an aqueous solution of 2, 3, 5 - triphenyl tetrazolium chloride for about 8 hours, when the living parts are stained an intense carmine red.

It was reported that several German seed testing stations in south west Germany had adopted this method including the Petkus Station where as many as 9,000 rye samples and 7,000 samples of oats had been tested in one season.

It had been demonstrated by this method of staining that vitality remained in some malt corns if they had been dried at low temperature on the kiln.

The method has been taken up by local brewers for testing the germinative capacity of their barleys.

Apart from the advantage of speed as compared with the old germinative test, this method has the additional advantage that it may be used to test the cereal seed required for autumn sowing. Formerly it was possible to test only some 25% of the autumn sown seeds.

Finally, apart from the work on staining methods for germinative capacity, investigations are in progress concerning the survival power of seeds - i.e., to ascertain first, whether they are alive, and second, whether they are strong enough to withstand the normal soil fungi. If this work produces the results anticipated, it is believed that the new method will yield reliable information on this point in one or two days.

V. L. B.

Target:	Versuchs-und Lehranstalt fuer Brauerei.
Location:	Berlin-Nord 15. Seestrasse. 15.
Type:	School of Brewing, Research and Consulting Institute for Brewing.
Date:	13th July and - 17th July, 1946.
Persons Interviewed:	Professor Dr. Drews - Scientific Head of Institute.
	Professor Dr. Koch.
	Dr. Vogl.
	Professor Dr. Bausch. For activities see Staff List.
	Dr. Weber.
	Dr. Silbereisen
	Dr. Broehl.
	Dr. Ing. Vinz.
	Dr. Pauly.
	Dr. Kolbach.
	Dr. Antelmann.
	Dr. Just.
	Redakteur Borkenhagen.
	Herr Weicha.
	Prof. Dr. Stockhausen.

A. Introduction.

This Institute was one of the two main centres associated with teaching and research in the Brewing Trade in Germany, and the general structure was of interest. The V.L.B. was divided into eight sections, of which the Brewing Section was the largest. The buildings and grounds are State owned. The Institute as such was classified as part of the Faculty of Agriculture of Berlin University and departmental heads ranked as Professors of Berlin University. Maintenance costs were borne by members of the Brewing Trade, membership being voluntary and based on contributions according to barrelage as detailed in Appendix B.

The Institute had been severely damaged in all sections by aerial attack. The experimental brewery had been patched up and was now operating on behalf of French Occupying Troops, the malt being supplied by the French Authorities. The Laboratories had suffered very severely and a considerable amount of scientific equipment, including practically the whole of the library containing some 24,000 volumes, had been evacuated by the U.S.S.R. Contents of the library have, to a certain very limited extent, been replenished, by donations from the private collections of members of the staff and subscribing breweries. Two floors in the laboratory building have been partially reconstructed. The floor maltings had been completely burned out with the exception of the kiln, which was still in good order apart from the clearing of debris.

It should be noted that in the initial period of our interview, the atmosphere was definitely cold and unhelpful, and this was presumably due to their fear that further plant and equipment might be requisitioned and evacuated. When it was made clear that this was not contemplated, there was a considerable relaxation in their attitude towards us, and information was given freely.

Of the former staff it was reported that Professors Gesell and Schoenfeld were dead, and that Professors Hessemer and Stockhausen and Herr Jordan had been pensioned off. Herr Naumann had also retired. Dr. Fritz Windisch was working in a Brewery in Hesse and was reported to be considering the possibility of founding a Brewing School in the British Zone. Dr. Göpp was now living and working at the Heine Barley Breeding Station at Schnega in Hanover in the British Zone. Herr Fink and Herr A. Ruckdeschel were both classified as Nazis and were thought to be working at Irex A.G., a malting concern at Kulmbach in the U.S.A. Zone. The present staff was as enumerated on the attached schedule, in which details as to their wartime, present and anticipated activities are also given (Appendix A).

Both the V.L.B. and the Kaiser Wilhelm Institute had been allowed to continue their work normally during the war without restriction, but in actual practice there was a considerable contraction of their activities due to the fact that personnel were called up for war service and replacements could not be obtained.

Their main activity during the war period had been directed towards closing the protein gap in German food requirements. This work was essentially the utilisation of yeast for feeding and fodder purposes, and the utilisation of whey for brewing. Other malt substitutes had also been sought, such as wheat malt in those areas where there were surplus stocks of wheat. High coloured malts with unimpaired diastatic activities were also sought.

They had been requested by the U.S.S.R. Authorities to work out schedules and plans for a series of breweries of three standard outputs to be constructed under their latest plans, one section of which, according to reports, called for new breweries capable of producing a total of 10,000,000 hectolitres (6,114,280 Brls) per annum. The V L.B. had not taken on this work as it lay outside their scope and was more suited to consulting engineers than a research institute. At the moment, they were actively engaged in organising, as far as present circumstances would permit, a reconstruction of the Institute from all viewpoints. Apart from this, they were again taking up their consulting and analytical work.

When interrogated with regard to the activities of the Weihenstephan Institute, they professed ignorance, and further stated that, in their opinion, that Institute was not concerned so much with original research as with the publication of textbooks.

Herr Vinz, who was engaged on the machinery side, to give an example of the work his Department was now doing, stated that they had been called upon to carry out a valuation of one of the Berlin Breweries - the Loewenbrau Bohmisches Brewery - which had been severely damaged by aerial attack. The technical machinery was valued at approximately Rm.6,000,000 but now, working on pre-war values, machinery to the value of only some Rm.2,000,000 remained. In this case the essential components of the plant were still intact, although the bottling stores had been very badly damaged and the floor maltings destroyed. The drum malting section remained intact, but no fuel was available to operate it. This brewery had been brewing beers at 10% to 11% prior to the war and had, during the war period, dropped down to 6%. In this particular case repair licences had been granted, following the valuation carried out, to cover the machinery necessary for essential production.

Their records of machines and their performances lost in the West Block when it was burned out.

B. Raw Materials.

Hops. It was feared that shortages of manures and sprays would harm the 1946 hop crop. Apart from this, however, the outlook seemed good. Normal yearly production figures were not available after 1939. They stated that the 1939 figure was 360,000 cwts, but this figure was obviously not correct. The crop figures had not included the Czechoslovakian hop fields. There was, from 1938 to 1939, a decrease of the order of 625 acres in the planted-up acreage. Reports had been received by them to the effect that the area under hop cultivation was to be increased, and that permission would be granted for the export of hops.

C. Substitutes.

Apart from the malted wheat which was used to a certain extent as a substitute for carbohydrate in those areas where there was a wheat surplus, only whey had been used on any appreciable scale for brewing.

D. Plant.

Brewing Plant. In France, the Mash filter was in common use as they used raw grain, but it was not in general use in Germany. The Mash filter was more expensive from the labour viewpoint but this, for a very long time, had been more than offset by the great advantage that the grist could be ground to a finer degree. However, with the modern design of Lauterbottich it was now possible to get as high a yield of extract as with the mash filter. The V.L.B. had had no practical experience in their own brewery with this type of filter. Tests on centrifuging the mash had been planned, but could not be commenced owing to the incidence of the war. The centrifuging of beer was not regarded as being satisfactory owing to its detrimental effect on head retention. During the war, the V.L.B. worked out and developed a process for regenerating filter pulp, the main feature of which was the considerable saving in fuel and water. This process formed the subject of a German patent, and the text is attached hereto. (Appendix D).

Whereas Kolbach stated most emphatically that stainless steel was the best material for fermenting vessels, his opinion was not shared by Dr. Pauli. The latter regarded stainless steel fermenting vessels as being far too expensive, although they had found some use in Western Germany in the immediate neighbourhood of the stainless steel makers. He considered the main danger to be the possibility of weld decay. Apart from this, if not insulated properly, they would corrode as badly as aluminium vessels. (The method of obtaining effective insulation was described in detail in the Wochenschrift für Brauerei 1931, page 407). Usually, they were insulated with some form of asphalt. Gundrung was mentioned in this connection.

Although aluminium fermenting vessels were used very extensively, they had the drawback that they could not be cleaned with caustic preparations. The normal preparations used in Germany for cleaning them were Petralit, manufactured by Rosenzweig and Baumann of Kassel, T.B.T., a sulphonic acid derivative, and diluted nitric acid.

Ebon lined vessels gave very satisfactory service provided that the concrete was well laid by a first class firm of Constructional Engineers specialising in concrete work and the foundations were protected against subsidence. If subsidence occurred and there was any vibration, hair cracks were likely to develop and trouble to ensue. Various types of substitute materials had been used and found highly satisfactory for pipe lines. The principal materials were Jena glass, Plexi glass, Vinidur, and Mipolam. The latest types of synthetic tube on the market would withstand temperatures of 120°C (248°F). They were considered to be better than tin or block tin pipes as tin itself frequently caused turbidities in beer.

Malting Plant. Aerated silos for the storage of grain were built by Rank Brothers of Munich, M.I.A.G. of Braunschweig and Klotz - Gleidbaum of Frankfurt-am-Main. An installation by the latter firm could be inspected in the West Harbour, Berlin. Generally speaking, barley silos were now constructed for aeration. This had the advantage that if the barley became infected with weevil, it could be disinfected by gassing. Normally, when barleys developed weevil they were steeped immediately. Although results were good with aeration, they, nevertheless, thought it better to store the barley dry. Work had been under consideration to examine the advantages or otherwise of using grain dryers. The tall, narrow type of silo was said to be most advantageous.

They expressed the opinion that, under the best conditions, there was no difference between malts made on the floor and those made by the Saladin and Kropf systems. Drum malts were generally considered to be of inferior quality. When working on large bulks of barley, there was no doubt that the Saladin system of box malting gave as good results as floor malting. With smaller quantities, however, floor malting was preferable as the grain could be better controlled in relation to its characteristics. In the trade floor malts were still regarded as being superior to box malts as they were more regular in quality. The estimated loss with box malting was 8% to 9% as against 10%, with floor malting, both values being calculated on dry matter.

The main difficulty associated with the Saladin system of box malting was the question of aeration. The system had been modified by Kropf so that smaller quantities could be handled and turning eliminated. Aeration only was necessary, and as such was restricted, higher yields of malt were obtained from any given quantity of barley. This system can be seen in operation at the Weissheimer Maltings, Andernach and at Wolf at Erfurt.

Malting equipment was made by numerous firms. Steinecker of Freising manufactured the Schuster turner, M.I.A.G. of Brunswick made the Seck mill, barley dryers and silos. The latter concern had taken over the Gel-mania Works at Chemnitz, where a floor turner was also made. It was not a free running turner and had been installed at the Walsheim Brewery, but reports had been received to the effect that all the plant from that Brewery had been evacuated. The Ergang turner was manufactured in Magdeburg, but no information was available as to where it could be seen in operation. Topf, one of the foremost manufacturers of malting plant, had their factory at Erfurt in the U.S.S.R. Zone, and reports had been received to the effect that all their technical data had been evacuated to the U.S.S.R. Further reports stated that they were recommencing the production of screening plants.

The marble-like finish already referred to in other sections of this report, was obtained by the use of “Diamant” cement. This was a normal cement with metallic additions. It was suggested that Krick of Frankfurt am Main and Rostock, Behrlocher of Kloster near Vienna, might be able to give further information.

The malt kiln at the Brewing School was still intact and had been converted from a two floor kiln to the Muger system. Schematic drawings were obtained and are available for inspection. This type of kiln was built by the firm of Muger in Darmstadt, and offered great advantage by the saving of labour and fuel. Aeration temperatures were registered in the air mixing chamber beneath the floor. The kiln was served by a vertical fan approximately 48" in diameter, of the blower type such as is used for barley drying drums of 50 cwts. capacity. The fan was mounted directly over the fire, which was thermostatically controlled by the closing of the air inlet. The top floor of their old existing two floor kiln had been converted to the Muger type by sealing the chimney. Air was blown through the green malt and circulated as in the Saladin malting system. There was an air mixing chamber between the fan and the kiln floor which was the equivalent of the normal chamber in an English kiln. A spark box was fitted above the fan in the air chamber. The green malt was loaded on to the floor of the kiln to a depth of 110 cm. (43 in.) For dark malts they dried at 100°C. (212°F) and for light malts at 90°C (194°F). The moisture content of the green malt was 40%, and it was reduced to 3½% after 18 hours. The circulation of air on the kiln had the following two advantages:-

(a) a reduction in respiration losses as a result of the reduced oxygen content and increased carbon dioxide content, and

(b) a saving in fuel as a direct result of the circulation of the air.

The Muger kiln was as implied by this description, a one floor kiln. There was no difference in the loss which could be determined when operating with the Muger kiln as against an ordinary kiln.

Although the floor maltings had been destroyed, it was noted that lavatories had been provided for the men on each floor. They had no knowledge of the vacuum drying of malt in Germany.

They had not seen the maltings at Herford and generally speaking, air conditioned maltings in Germany were equipped with direct expansion brine cooling plants. It was the modern practice to place the brine pipes on the side walls and to erect drip-trays beneath them, clear of the floors.

E. Containers.

The three main German cooperages were Dorn and Dressler in Munich, Klein in Kitzingen, and Mann in Kassel. There were no cooperages in Berlin and, speaking generally, there was a shortage of timber, and it was not considered likely that supplies of either timber or casks would be available for export.

As metal casks had no heat insulating properties, it was considered essential for them to be packed in ice during rail transport. Stainless steel casks were principally manufactured by Rosista of Dortmund. Muller of Schwelm had manufactured steel casks with a glass lining, but they had not proved to be satisfactory in service. It was the general opinion in German brewing circles that white bottles were obsolete. Of the coloured bottles, amber was regarded as the best.

F. Process

It had been planned to make comparative brewings using floor malts, box malts and drum malts. Such trials would have been on a commercial scale, but, owing to the intervention of the war, it had not been possible to proceed with these investigations.

Proteolytic malt was manufactured at Mannheim by licensees who work the Dixon patents. The V.L.B. have no knowledge of the operating conditions at Mannheim. Special malts were produced by the Weyermann Crystal Malt Factory, Bamberg. Torrification was not practised in Germany as the necessity did not arise.

Bottled pale beers required for effective pasteurisation, treatment at 63°C. (145°F.) for one hour and malt beers treatment at 75° to 80°C. (167° to 176°F.) for one hour. The temperatures given were, in each case, beer temperatures.

G. By-products.

Spent grains were utilised for fodder, being sold either wet or dry according to the season and the location of the brewery concerned. Spent hops, during the war period, had been utilised for paper-making, upholstery, and as a tobacco substitute.

H. Research and Scientific Work.

Barley. The primary requirement during the war years had been the development of a barley giving a high yield per acre and the main work on which Göpp had been engaged was the improvement of barley races. Any barleys which did not satisfy the above criterion were immediately discarded. Of the new types developed, Haisa gave the best results. Not only were laboratory tests carried out, but also practical brewing tests, the final beers being subjected to critical examination. No samples of these new barleys were available. In the West Wing fire there were lost the records of three years of Göpp's work, which was reported on by Kolbach. (A copy of the Wochenschrift für Brauerei 1941, No.13, containing an interim report on Göpp's work on page 33 was furnished.) When permitted, it was intended to take up work on the brewing side with these new barleys at the V.L.B. No work had been carried out on barley storage or the drying of green malt. Empirical observation had shown that the quality of barley was improved by drying and storage for four weeks, although, as the normal moisture content of German barley was only 15 to 16%, drying was seldom necessary. When barleys are dried these are usually stored up to two weeks before doing so. Further details on this subject were given in the Allgemeine Brauer Und Hopfen Zeitung 1940, page 465: It was stressed repeatedly that German barleys normally had a low moisture content and did not require to be dried.

They had no direct experience of the selenite and tetrazolium methods for determining the germinating capacity of barley. They saw no great advantage with these methods as against the natural ones, except perhaps when used directly after harvest and when the barley was in a dormant condition. Of the two methods, the tetrazolium method was to be preferred as the colour was more readily distinguishable.

Brewing. Kolbach reported on the brewing process and on fuel saving. During the course of the war the strength of beer fell from 12% (1048°) to 0.4% (1001.6°) and one of their chief problems was to produce, in such an attenuated product, a reasonable flavour. In the interests of fuel economy, beers were brewed at 12% and broken down. At first the dilution had been carried out with a boiled hop infusion, but, as this gave a very bitter flavour and there was no great saving in fuel, this method was discontinued. During the 1914-1918 war, Windisch had developed the theory that the lower the gravity the higher should be the proportionate hop rate. Experience in this war had proved this theory to be unsound and hops had been added on a volume basis and not according to the gravity of the beer. Nevertheless, proportionately more hops were used in the lower gravity beers, but not in the relatively high proportion of the 1914-1918 war period. Quite apart from the quality viewpoint, it was also necessary to reduce the hop rates through acute shortage of hops. The theory was developed that, if a beer had no taste of malt, then it should at least taste of hops, but an excessive hop rate led to the development of a bitter-gall flavour in the finished beer. At the present time standard hop rates in the British Sector of Berlin were 80 grammes per hectolitre (4.62 ozs, per barrel) and in the U.S.S.R. Sector 75 grammes per hectolitre (4.33 ozs per barrel).

They had found that the best time for reducing wort with liquor was in the fermenting vessel at the height of fermentation. Originally this liquor was boiled, but, to economise in fuel, it was added unboiled after slight chlorination. The chlorine had no influence on the beer. If necessary, the liquor was decarbonated by lime treatment prior to use. Acid treatment was much simpler but was prohibited by German law.

They had ascertained as a result of their comparative samplings throughout the war period, that 9% (1036°) beer had the best flavour. With low gravity beers the carbondioxide content began to play a significant role with regard to both flavour and control of infection. By the normal lager process, a 12%, beer (1048°) would contain in the finished condition 0.38% of carbon dioxide. With 3% beers (1012°) and over, the necessary carbon dioxide content could be developed naturally. Theoretically, it was possible to develop sufficient carbon dioxide naturally with 1.5% beer (1006°), by retaining all carbon dioxide developed during fermentation, but, in practice, this had not been found possible and carbonation was necessary. It was recommended with present low gravity beers to aim at a minimum carbon dioxide content of 0.40%. Cases were known where it had been raised to as high a figure as 0.46%. For a maximum effect on flavour and control of infection it was essential for the carbon dioxide to be in effective solution. They had also investigated the effect of the salts present in the liquor used for breaking down the wort. The salt content of the liquor for these diluted beers was found to be important, and the calcium sulphate content was of particular significance. Dortmund type beers were brewed with calcium sulphate hard liquor and Pilsen type beers with soft liquor. Professor Windisch had stated that the best beers could be made from distilled water, as a result of which many breweries had erected large and expensive plant to eliminate calcium sulphate. Modern theory suggests that calcium sulphate does no harm except in very high concentrations. Generally they appeared to subscribe to the opinions long held in this country on the relationship between calcium sulphate content and hop flavour. A formula had been developed by the use of which the pH of the wort could be calculated from the calcium sulphate content of the brewing liquor. It was thought that this formula would only apply to weak beer. It had been necessary with the low gravity beers to make a special effort to develop a pleasant hop aroma. The best results seemed to be obtained when the hops were added at the end of the boil, say, five minutes before turning out the copper. Even better results were obtained if a portion of the hops was added in the hop-back or storage tank. Such additions should be of the order of 60/80 grammes per hectolitre (3.5 ozs, to 4.6 ozs. per barrel). The total hop addition with Pilsen type beer was 340 to 360 grammes per hectolitre (19.6 ozs. to 20.8 ozs. per barrel), and with normal type beers 210 to 230 grammes per hectolitre (12.1 ozs. to 13.3 ozs. per barrel). Of these totals 60/80 grammes per hectolitre would cover the addition either in the hop back or in the tank in order to secure the additional and desirable hop aroma. Generally speaking, however, brewers had neither welcomed nor accepted this method of providing an additional pleasant hop aroma, and they were unwilling to educate the public palate to a new flavour. The additional hops, added in accordance with the above recommendations, caused some loss of head retention. Naturally, the quality of the hops and the storage temperature influence the amount to be used. For instance, Wurtemberg Tettnanger hops tend to lose their flavour more rapidly than Bavarian hops.

During the 1914.-1918 War considerable difficulties had been experienced with physico-chemical turbidities consisting essentially of albumin-tannin complexes, but there had not been any great trouble with such turbidities during this war. Cases were known where pure inorganic turbidities had arisen through the precipitation of phosphates if the brewing liquor was not treated correctly before use for breaking down. In the particular case investigated, the beer had a pH value of 6.5.

The biological problems associated with the production of low gravity beers were reported on by Stockhausen. With a normal 12% (1048°) beer, the yeast required to be changed after some 30 to 40 generations, but, with low gravity beers, it had been found necessary to change the yeast after 5 to 6 generations. When brewing at low gravity, the yeast crop was extremely small and microscopic examination revealed a high percentage of dead yeast cells which tended to give a yeast bite to the finished beer. As a result, they had adopted the method of brewing 12% (1048°) beer, starting fermentation normally, and diluting during fermentation immediately after the main yeast reproduction period was over. This method had the added advantage that the carbon dioxide content of the beer would reduce, or inhibit to a great extent, infection from the breaking-down liquor. If the beers were broken down in storage tanks or at the racking stage, then the resultant beer had a bad flavour and was biologically unstable.

Biological instability was found to be due to various organisms, according to the strength of the beer. If the breaking-down liquor was not decarbonated, the pH of the resultant beer would be changed to the alkaline side thus favouring bacterial infection. On short term tests, it was found that the main infection with 12% beers was sarcina, with 9% beers wild yeast, with 6% beers torula, and with 3% beers liquefying bacteria. Their investigations were carried out by taking a 12% beer and diluting to the various standards specified, and then adding mixed infection. On short term tests results were as indicated, but long term tests had shown that the organisms were adaptable and that general infection ultimately developed in beers of all standards.

One of the most serious problems the German Brewers had to solve during the war period was the development of a yeast that would stand up to the special conditions resulting from the brewing of low gravity beers. To encourage a vigorous after-fermentation two methods were adopted; firstly, the addition of a very active after-fermenting yeast when racking into storage tank, and, secondly, fermentation with two different yeasts, adding one at pitching and the other at racking.

Stockhausen had investigated many samples of wild yeast which, on microscopic examination, had appeared to differ morphologically. Recultivation over a period showed, however, that they were all derived from normal strains of wild yeasts. It was concluded that the morphological differences were due to variations in environmental conditions.

Even before the war, because of the increase in motoring amongst the general public, sports activities, and, last but not least, the introduction of blood alcohol tests by the German Police, investigations had been carried out with the object of finding a new non-alcoholic beverage. This work had been allowed to proceed. It was considered essential that even though such a beverage could not be classified as a beer, it should, nevertheless, have a beer flavour. The lemonade class of beverage was not regarded as satisfactory. Also the U.S.A. method of fermenting normally and boiling off the alcohol was not acceptable. So the main line of approach had been the development of a wort with a low maltose content and in which only some 24% of the wort solids were fermentable compared with some 62% in a normal wort. Such a wort was obtained by the Windisch mashing process with a short saccharification. This special wort gave a black iodine reaction even at the end o f the mash. It was the general opinion that a much better so-called non-alcoholic beer than had yet been produced could be developed along the lines just indicated.

For a beverage to be classified by German law as non-alcoholic, its alcohol content by weight must not exceed 0.5%. Comparative tests on products containing 0.6% and 0.4% alcohol by weight showed the former to be very much superior in flavour, and steps were being taken at the outbreak of the war to have the law amended so that a beverage with 0.6% alcohol by weight would fall within the non-alcholic classification. These negotiations were interrupted by the war.

Reference was made to the special Ludwig beers. In the preparation of these beers, mashing was controlled so as to give a high percentage of maltose in the wort, which was then fermented by the special yeast S.ludwigii. This yeast does not ferment maltose and beers were produced with not more than 0.5% of alcohol by weight. It was recommended that one percent of cane sugar be added. It was advisable to brew Ludwig beer in a separate brewery and preferably by the Nathan system. Its manufacture was covered by a patent valid both in the U.S.A. and Germany.

Recently, they had developed a so-called whey beer, and it was difficult to draw a comparison with any known beverage. The whey was heated to 70° to 80°C. (158° to 176°F.) and then cooled to 30° to 35°C. (86°F to 95°F.) It was of. paramount importance that the temperature after cooling should not exceed 35°C (95°F.). A lactic ferment was then added, the product bottled and fermentation allowed to proceed. The fermentation was effected by means of B.Lactis or B.Fragilis and if this is carried out at too low a temperature, Mycoderma developed. Saccharin was added before bottling to give additional sweetness. This beverage was developed during the war and was now very popular due to the shortage of beer, but it was not considered likely that, in normal circumstances, it would have obtained any degree of popularity. It was consumed neat or diluted to the extent of one-half or one-third with water. In Berlin the housewives were using it for the making of whipped cream, soups and vinegar.

The product was similar to Berlin white beer, and produced a creamy head. In appearance it was rather like soapy water, while the smell was sweetish, but not unpleasant, and it certainly had thirst-quenching qualities. It contained approximately l% by weight of alcohol, was rather turbid and had a most undesirable whey or cheesy smell. The smell was definitely that associated with cheese fermentations, but the opinion was expressed that the smell would not develop if manufactured from absolutely fresh whey. It was believed that the addition of fruit juices would improve the product. It could be clarified and made bright, but did not remain permanently so as the proteins soon precipitated. The beverage was not being clarified at the moment as the proteins resent (to the extent of some 6% in the original whey have definite food value. Its manufacture in a normal brewery was not desirable owing to the great danger of infecting the running beers with lactic ferments.

They had done no work during the war on the influence of metals on beers. The arsenic content of beer was limited by law, but this matter was not regarded as of major importance as the malts were dried and cured by indirect heating. They had no knowledge or methods for removing arsenic from malt and yeast preparations.

On vitamin research, the work carried out before the war by the V.L.B. was reported in their Year Book for 1937-1938. A further report was issued in the Wochenschrift für brauerei 1941 - 1942, but later work had not yet been published and was reported on by Dr. Just, who had, been working in co-operation with Fink. They had got to the stage where Fink was to publish the work, but this had not been done, as, owing to zonal separation, he could not meet Just to complete the writing up. At the moment, Just was not active at the Institute. Fink was regarded as a patent seeker who was unwilling to publish interim reports on his work in order to prevent other workers in a similar field from forestalling him with a patent.

On the biological synthesis of proteins, the chief studies had been carried out on yeast strains which had low bios requirements and which were capable of getting along with sugar and other readily available sources of carbohydrate plus inorganic nitrogen, phosphate and calcium. Potential sources of carbohydrate, such as sulphite effluents and fish water residues, had been investigated.

On the production side, the main problems concerned transport, corrosion of vessels, aeration, manufacture of yeast and changes in its characteristics. In the last case, it was desirable to ascertain whether the changes were caused by environment or whether they were of hereditary type. They therefore investigated whether such changes were permanent or otherwise.

The initial research was confined to the development of cattle fodder but, later, as protein shortage became more acute, they endeavoured to develop yeasts suitable for human nutrition. In the latter case, it was necessary to establish whether the yeast contained any constituents harmful to the human body. Work carried out on these lines had not been published as it was thought likely to alarm the general public. They soon found that, when small amounts of impurities, such as lead, copper and arsenic, were present in the substrate, these were concentrated almost entirely in the yeast. Just made no reference to the possibility of yeast purine being harmful - cf. work by Macrae on pigs and various reports by Bunker.

Nutritional tests were carried out on fodder yeasts, spent grains and trub by means of chemical analysis and by deficiency tests. Difficulties were encountered in the protein analysis due to the lack of precision in the methods themselves, to the variation in the type of raw material leading to an overlapping in group classifications, and to the fact that it was not known how many of the amino acids were necessary for full nutrition. For this chemical investigation they adopted the Van Slyke method using acid hydrolosis of the total protein material. This method was not regarded as exact enough to give absolute figures but, nevertheless, all workers in Germany had been instructed to use the same method and technique so that the results could at least be directly compared. In addition, Balint's method of estimating cystine and glutathione was also included. For the deficiency tests, biological methods in which at first adult rats were the test animals were used. But adult rats, being fully grown, could withstand malnutrition for a considerable period before collapsing, and it took too long to obtain decisive results. It was therefore necessary to change over to young rats and work by making comparative growth rates, using mothers' milk as the control medium as this, quite obviously, was the ideal form of nutrition for such young rats. By substitution they showed that all the protein sources indicated above were deficient. If one-third fish protein or normal protein was substituted in the mothers' milk diet, they found that growth rates were still normal, but if proteins from the other sources were used, then growth rates were not satisfactory. This method only indicated whether or not any particular product was good or bad, and not the reason for any deficiency.

The chemical method showed that there was a cystine deficiency in yeast protein. This conclusion was confirmed by adding 2% cystine to the yeast protein used in the feeding experiments. Normal growth rates were then obtained. With torula yeasts, however, growth rates were still not satisfactory. They also ascertained that the test animals developed a liver disease due to torula yeast containing some substances which the liver could not detoxicate. Some doubt exists on this point as it was not yet clear whether it was actually a toxic effect or a further deficiency.

Their next investigation was directed towards remedying these deficiencies. Cystine cannot be readily synthesised but it can be obtained from cystine-rich proteins such as hair, horn and hooves. The chief difficulty in using such sources of supply was to bring them into a palatable form. The keratins, in the cystine sources indicated, were made available either by complete acid hydrolysis, which unfortunately destroyed a considerable percentage of the cystine, or, alternatively, by partial acid hydrolysis in accordance with a patent taken out by Grossmann. A further source of cystine was found in by-products from slaughter houses which could be rendered available by chemical treatment. It was, in addition, ascertained that cystine could be developed in the yeast itself by growing on a suitable substrate. It was their intention to continue work on the synthesis of cystine when possible.

In German wartime diet, there was a big deficiency of vitamin B, and this increased with the changing nature of the basic diet towards the end of the war. In normal times beer production provided a large excess of yeast as a by-product which could be utilised as a source of Vitamin H, but this alternative source fell away as low gravity beers were brewed. It was found that food yeast was much poorer in vitamin B, than either baker's or brewer's yeasts, the relative proportions being about 1:3:10. Food yeast, nevertheless, still had a much higher B, content than many foodstuffs, and.it became a valuable source of this vitamin in the basic diet of the German people.

The losses of vitamin B_1 in working-up food yeast are relatively higher than with brewer's and baker's yeast, and it was desired to increase its vitamin B_1 content. They were able to show that this vitamin Bl enrichment of yeast could be effected simply by the addition of pure vitamin B_1 to the substrate. This method was obviously impracticable as crystalline vitamin B_1 had then, in the first case, to be synthesised. It was then demonstrated that the vitamin B_1 taken up by the yeast was converted to co-carboxylase - i.e. aneurin pyrophosphate. Further investigation showed that the yeast could synthesise aneurin pyrophosphate for the intermediates pyrimidine and thiasole. Recovery was practically 100%, and in this way it was possible to enrich the yeast vitamin B_1 content from relatively simple materials and to obtain a final product which contained ten times as much vitamin B_1 as brewer's yeast - i.e. 100 times the content of normal fodder yeast. This synthesis from relatively simple materials of highly complex organic products with good nutritional value was regarded from a purely scientific standpoint as the outstanding feature of these investigations.

Vitamin B_2 shortage was not regarded as a serious danger in Germany and no work had been undertaken in this connection.

A certain amount of work had been performed on the subject of pantothenic acid by Kuhn, Wieland and Möller. Investigations on nicotinic acid had been carried out by the standard bromo-cyanate method.

No work had been carried out at the V.L.B, on antibiotics.

Some work was done with the object of reducing the quantities of phosphate required for fodder yeast production in order to release additional supplies for fertilisers. They found that with their fodder yeasts, they were able to reduce appreciably the basic requirements in phosphate. This was not found possible with baker's yeast as with these yeasts quality definitely suffered if the basic quantities of phosphates in the substrate were reduced.

It was stated that reports on general lines relating to the above investigations and covering non-published work had been given to the Government Department concerned. To enable the individuals concerned to keep their scientific lead and to protect themselves should they wish to take out any patents, reports were not made in detail.

THE UNIVERSITY TECHNICAL COLLEGE AND EXPERIMETAL BREWERY, WEIHENSTEPHAN.

Target: Technische Hochsohuhe und Vsrsuchbrauerei.
Location: Weihenstephen/Freising.
Type: School of Brewing and Research and Consulting Institute for Brewing.
Date: 26th July, 1946.
Persons Interviewed: Professor Dr. Fischer - Head of Institute.
Professor Dr. Reindl
Professor Dr. Schnegg.
Professor Dr. Trautwein.
Dr. Kaiser.
Professor Dr. Raum.
Herr Kratz.

(For detailed information of staff see chart).

A. Raw Materials.

Barley. Prof. Raum reported that he had been removed from his position in 1934 as a result of the Nazis coming into power. His main work during the past twenty years had been concerned with the development of disease resisting barleys as it was believed that the limit had been reached so far as increased yield was concerned. In recent times, two-rowed winter-sown barleys had been studied but with very little success. During the Nazi regime relatively little work was done on malting barleys, the main effort having been directed towards the production of foodstuffs. The Barley Growers' Exhibition had not been held throughout this period, an outstanding feature of which was the great reduction in the number of barley varieties grown commercially. The Imperial and Chevalier varieties had dropped out entirely, and only a few of the long haired basal rachilla type remained. Actually only ten of these barleys were now in general cultivation - the chief being Isaria, Haisa, Corgina and Hadostreng.

Combine harvesters were not really suitable for use Germany as the climate. was too damp. Furthermore, they had very little coal and consequently they could not undertake the drying of the grain. Grass dryers had been considered and investigated to a limited extent but not fully because the process was too expensive and the necessary fuel was not available.

They reported that the German Army had built numbers of very expensive grain storage silos, all equipped with aeration plant, but expense was not a matter to which the Army gave much thought. The two contractors employed by the Army were Topf of Erfurt and “MIAG” of Brunswick.

Very little trouble had been experienced in Bavaria arising from weevil in barley, as past care and attention had, for all practical purposes, removed this danger. When necessary, carbon disulphide had been used in grain silos but this was associated with the risk of explosion. During the war period barleys had been received on occasion containing weevil, but they had been malted immediately and the trash destroyed by burning.

They did not regard the selenite germination test as satisfactory nor were they familiar with-any recent work on rapid germination teats, including the tetrazolium method.

Hops. They had not carried through any work on new hop varieties. Formerly, there had been ten or more varieties in regular cultivation in Bavaria but these had now been reduced to four - Hallertau, Spalter, Saaz and Tettnang. A Hop Breeding and Research Station was established at Huell, but the breeding of new types was really only in its infancy. They expressed. some surprise at the number of types bred in England and thought that American hops were poor in quality - at least for their purpose.

Throughout the war, hop growers had received adequate supplies of chemical manures and sprays and they had not experienced any serious trouble through disease. Motor driven sprayers were in operation, using Bordeaux mixture as Perenospora was the main disease attacking their hops. They had no knowledge of the virus diseases of hops but they knew that potatoes were subject to virus attack.

The chief chemical manures in use were nitrophosphate, ammonium sulphate, sodium nitrate, ammonium nitrate, and calcium cyanide.

Natural manures were used mainly by smallholders who in consequence kept their own animals, thus upsetting the economic balance of their farms. In the Hallertau district hop cultivation was a matter of major importance, and everything possible was done to ensure first class crops. Thus, in order to secure adequate supplies of natural manure for the hop gardens, there had been no reduction in the number of cattle during the war.

It was found that the use of organic manures or high nitrogen artificial manures lead to the production of hops of coarser character having loose cones; on the other hand the yield was increased. Hop propagation was effected by means of cuttings and no other method was employed.

No investigations had been carried out to ascertain the susceptibility to disease of hops grown with natural and artificial manures.

According to Bavarian State Law it was only permissible for a hop grower to increase his area under hops by a maximum of 10%. The hop gardens were usually from 10 to 50 hectares (25 to 124 acres) and occasionally up to 100 hectares (250 acres). During the war period the acreage under hops had been reduced. They had no mechanical pickers in operation.

They were anxious to see a revival of the hop export trade, particularly to America, as a means of paying for some of their imported foodstuffs or on a barter exchange basis.

The acreage under hop cultivation had been further reduced since the end of the war, and they could offer no positive suggestions as to how and when output of hops could be increased.

It was reported that the top price paid by Americans in 1945 for hops was Rms.350 per cwt.

It was estimated that the Hallertau 1946 crop would be 55/60,000 cwts. Spalter and Tettnang hop production had to be added to this to get an overall figure. Approximately one-third of the hop gardens had suffered damage from rain and hail this season. The cold storage of hops at approximately 35.6°F (2°C) was essential in their opinion.

B. Substitutes.

As the use of adjuncts in beer was prohibited by Bavarian law hop concentrate could not be used.

Large quantities of hop concentrate, however, had been used in northern Germany but the brewers there were far from satisfied with the results obtained, and as they had no means of checking the quality of the original hops from which the concentrate was made, this adjunct was now almost out of use.

It was known that in the beet sugar growing areas at least one brewery was operating with beet sugar residues and producing 2% beer therefrom.

C. Plant.

Brewing Plant. Prof. Schnegg said that metal fermenting vessels were superior to wooden ones as the latter tended to be of small capacity compared with metal vessels and were consequently extravagant in the use of available fermenting room space. He recommended a maximum capacity of 300 hectolitres (183 Brls.) with an optimum depth of 2 metres (6' 6") and a maximum depth of 2½ metres (8' 2") for fermenting vessels.

They had one stainless steel vessel in operation which gave excellent service and this experience had been confirmed by reports from breweries where such vessels were installed. The insulation of stainless steel fermenting vessels was regarded as desirable though not essential and they recommended 2" of cork insulation in direct contact with the steel without any additional asphalt or jute impregnated-fabric. The cork was protected by a. covering of brick or concrete. They regarded highly polished mirror finish stainless steel as essential to prevent deposition of beer scale and suggested fabrication with steel sheets 1/10th of an inch thick.

The use of aluminium in the construction of fermenting vessels was condemned out of hand and they stated that the reputation of the metal, which was formerly supplied with a 98% purity, had suffered seriously on this account. It was now customary to supply the metal with 99.8% purity. A steady growth of beer stone was deposited on aluminium fermenting vessels. Kratz stated that the one in the brewery had formerly been cleaned with nitric acid but now they made use of Mammut-oxalit which was believed to be an organic sulphonic acid. No nitrous fumes were developed when it was in use.

The brewery mains were made entirely of copper and were cleaned without dismantling - with a 1% solution of formaldehyde and occasionally with caustic soda solution. The mains were completely dismantled every six months.

They used plug cocks throughout the brewery which appeared to be inferior to our own modern designs.

Malting Plant. In the absence of Dr. Leberle, Dr. Fischer reported briefly on matters relating to malting. He expressed the opinion that there was no difference in the quality of malts whether produced by the flooring system or in the Saladin box. With the latter system, however, not only were the malting losses somewhat less than with floor malt, but the saving in labour charges was very considerable indeed. Many large maltsters who were strongly prejudiced in favour of floor maltings had been compelled by sheer economic necessity to convert their maltings to the box system, and cases were quoted where maltings producing half their output on the flooring system and half on the box system had converted entirely to box malting. All members of the Institute staff were solidly in favour of box maltings but, in accepting this testimony, it would be well to remember that the Institute was largely responsible for introducing the box system of malting and that, in these circumstances, it would be unnatural for them to condemn it. They did admit, however, that where a maltster was dealing with small lots of barley, better results could be obtained by floor malting.

An essential element of box malting was the handling of relatively large quantities of barley at each operation. If, in order to secure the large quantities of barley for each operation the maltster found it necessary to mix barleys of varying type, nitrogen content or recovery from dormancy, then obviously the regularity he desired could not be achieved and in such a situation malting on the flooring system using small pieces to accommodate each type or quality of barley would yield very much better malt.

D. Containers.

German oak was not suitable for beer casks and Rumanian oak was definitely preferred.

E. Process.

In the experimental brewery they had used 200/250 grammes per hectolitre (11.5 to 14.5 oz. of hops per brl.) on their pre-war 12% (1048°O.G.) beer and, at the time of our visit, they used 120 grannies per hectolitre (7 oz, per brl.) with the current 2% (1008°O.G.) beer. This was achieved by using 350 grammes per hectolitre (20.2 oz. per brl.) for the 6% beer brewed prior to dilution, and then reducing to 2% with water.

Prof. Schnegg had published some work on non-alcoholic beers and on the problems associated with low gravity beers. (Summary of both publications attached).

The low gravity beers were prepared by dilution from 8% (1032°O.G.) beer. When they brewed at 2% (1008°O.G.) the yeast would not function satisfactorily, having poor reproduction, and the resultant beers were also highly susceptible to infection. Prof. Schnegg had come to the conclusion that reducing water should be added in two portions; the first portion after 2 to 2½ days fermentation - i.e., when the main crop of good yeast has been obtained - and the balance when racking into storage tanks. Operating in this manner they had been able to develop up to 6 lbs, per square inch pressure in the storage tank. Experience had shown that if the entire addition of water was made when racking the beer into storage tanks, then the tank fermentation was upset and it was necessary to carbonate the beer. With care they had found it possible to produce 2% (1008°O.G.) beer without resorting to carbonation.

It was very important to avoid the use of boiled water for dilution. When boiled water was used the beer developed heavy bacterial infection picked up by the boiled water, on the flat coolers and in the pipe lines. This infection would not develop in 10% (1040°O.G.) beer. The practice in the State Brewery was to add water direct from the mains. In breweries where the mains water was not satisfactory they had resorted to chlorination with chlorine gas or hypochlorite. The flavour of the beer was unaffected if the chlorine addition was not excessive.

Prof. Schnegg had recently inspected two beers from the same mash - one sample diluted with a chlorinated water and the other with mains water. The beer made from the chlorinated water was undoubtedly the better. Prof. Schnegg had found that bacteria particularly sarcina which can be expected to develop in 10% (1040°O.G,) beer, had not developed in 2% (1008°O.G.) beer. Generally speaking, with 3½% (1014°O.G.) beer and upwards, normal infection was found, but below this figure B.coli, B.subtilis and Thermo bacteria developed if boiled water was used. It had further been determined that B.subtilis and Thermo bacteria did not develop in 2% (1008°O.G.) beers. It was proposed to carry out investigations to ascertain the cause of the development of B.coli in 2% (1008°O.G.) beer. He had not come across any other pathogenic organisms in beers.

Dr. Kaiser reported that there had been no difficulties experienced, even with low gravity beers, through non-biological turbidities.

Their beers were double pulp filtered, asbestos as an adjunct. Neither bulk beers nor bottle beers were pasteurised.

F. Research.

Prof. Reindl reported that prior to the war the biological synthesis of proteins had formed the subject of a great deal of work in which sulphite liquor had been used as the most convenient cheap source of carbohydrate. During the war, they had concentrated on the production of fodder and food yeasts from the same source. Their principal achievement was the production of a special strain of Torula utilis following a directive from the authorities to find the yeast which would provide the largest possible yield. In the early stages of the war, 100 grammes of sugar in the substrate gave a 38% yield of dry yeast, but with the new strain developed this was increased to 50%. They had no clear knowledge of how the new strain had arisen but they could state definitely that there had been no reversion in its character. They had found that the original yeast took up 60 to 80 milligrammes of lead per kilogramme from the vessels in contact with the sulphite liquor, whereas the new strain took up only 10 to 15 milligrammes per kilogramme.

Yeast protein could not replace meat protein in human diet because it lacked cystine. In experiments on rats it was found that, if the diet consisted of yeast protein plus cystine, the assimilability was improved, and the liver disease, which resulted when yeast protein alone was used, did not develop.

It was reported that the chief work on vitamins had been done by Fink and none of the present staff had been active in this field.

The production of alcohol from whey was, strictly speaking, forbidden by law, but was widely practised. The lactose-fermenting yeasts in use were M^2, which had been specially cultured at Weihenstephan, and S.fragilis. Cultures of M2 and other strain T50 were obtained from Prof. Reindl. Vinegar had also been produced from whey.

Some improvements in yeast races were anticipated following the work of Winge, on hybridisation, and Bauch, on comphor treatment yielding giant forms. Prof. Schnegg had not been able to detect any difference between pure yeast cultures developed from a single cell or from sporea. He had hoped to develop new yeast races. Prof. Schnegg expressed doubt as to whether Bauch's camphor treatment resulted in the doubling of the number of chromosones in the nuclei.

In view of the great increase in production of low gravity beers in recent years, German breweries had found it necessary to make use of pure cultures.

The main stock cultures of yeasts were preserved in 10% cane sugar solution by the well-known method laid down by Pasteur and sub-cultured for brewery supplies into wort. The main cultures were kept for five years in the same cane sugar solution and then transferred for growth into wort and afterwards returned to a fresh 10% cane sugar solution. Using this Pasteur technique, Prof. Schnegg had found no alteration in the physiological properties of his cultures during his 44 years activity in the Institute. The essential point was to introduce only a minute trace of yeast into the cane sugar solution. If an excess of yeast were used then fermentation developed and a change in the physiological properties ensued.

E. General.

This Institute is exclusively State supported and the attached graph sets out the general structure and staff Organisation. Prof. Fischer, Head of the Institute, also carries on his own private practice as a consultant engineer for breweries. In addition to the Institute as such, there is an Experimental Station, supported by the State if necessary, in which research work and experimental work is undertaken on behalf of brewery companies for suitable fees. Generally speaking, these fees more or less offset the cost of maintenance so that it is, for all practical purposes, an independent section. It was reported that the Scientific Station in Munich, destroyed by bombing, had been supported exclusively by the Brewer Members who subscribed on a barrelage basis.

Training of brewers was done very largely on a regional basis, the V.L.B. in Berlin covering north Germany and Weihenstephan south Germany. It was reported that Dr. Fink, expelled for Nazi activities, planned to set up a new brewing school in Munster to serve the Rhineland. It was suggested that such a school, if set up, would receive the support of the Dortmund breweries.

The Weihenstephan Institute had some 80 students at present, and 100 were entered for the following term. The normal number of students was 200, although in 1933/34 they had as many as 300, including numerous foreigners from the Scandinavian countries, Czechoslovakia and Yugoslavia. The normal course was of three years duration for students who had attained School Certificate standard on joining the Institute, and two years for students who had attained University Matriculation standard.

In suitable cases, reduced fees were charged to students after the application of a means test. An additional grant to cover subsistence was sometimes given by the State. Most students, however, had contacts with the trade and paid their fees in full. Some Scholarships had been endowed by breweries and allied traders, and, for these, the brewery or allied trader concerned nominated the holder without any qualifying examination.

There had been no question of general deferment of military service for brewers during the war but each case was considered on its merits by the local Labour Exchange.

YEAST WASHING PLANT

Target: Carl Prandtl.
Location: Munich 12 Mauerkirchen Strasse.
Type: Yeast Washing and Cloth Washing Plant.
Date: 27th July, 1946.
Person Interviewed: Herr Conrad Sill.

We ascertained that the head of this firm, Carl Prandtl, died many years ago, and the business had been taken over by an old employee, Herr Conrad Sill. After considerable difficulty we located Herr Sill at Mauerkirchen Strasse where he was interviewed. There was no evidence of any new development in the design of yeast washing plant.

Various brochures, dealing with their normal range of machinery, were handed over and also a diagrammatic sketch of the special nozzle fitted to their earlier and simpler types of yeast washing plant and are available for inspection at the address given on page 119 of this report.

CEMENT FLOORS

Target: Fritz & Martin Krick.
Location: Frankfurt Am Main. Georg Speyer Strasse.8.
Type: Constructional Engineers, specialising in erection of concrete tanks.
Date: 30th July, 1946.
Persons Interviewed: Herr Martin Krick - Partner.
Herr Fritz Krick - Partner.

The information previously received that this concern was specialising on the building of brewery and malting floors proved to be incorrect. At present their main activity was concerned with the installation of ebon lined concrete fermenting vessels and storage tanks. The principal difference between their method and those of others lay in the fact that they built the vessels in situ instead of having them pre-cast. It was claimed that their method made the vessels more reliable under pressure.

They had never installed any metal fermenting vessels but had been associated with the removal of aluminium fermenting vessels which were damaged by corrosion. They observed on such occasions that the corrosion occurred where the insulation was faulty. The type of insulation normally used in German breweries consisted of a tar-impregnated fabric.

When constructing floors intended for hard wear such as in a beer cellar, it was better to build on a solid earth foundation. Rough concrete to a depth of 4¾" to 6" (12 to 15 cms.) made from one art of cement and eight parts medium sized gravel 1½" (4 cm.) mesh was then covered with 1" (2½ cm.) of a fine mixture consisting of one part of cement and two parts of fine washed sand, applied in a thick consistency. It was essential that the rough concrete layer be thoroughly freed from dust before the fine layer was laid down. Concrete as specified above was laid between parallel iron rails which were removed after tamping and whilst the concrete was still green. The spaces were filled in with fresh concrete and the final surface finished by polishing first with a wooden float and finally with a steel one. Where very heavy wear was anticipated, steel filings could be incorporated in the top layer of cement and even better results were obtained if stainless steel filings were used. Such floors could be repaired satisfactorily. It was indicated that both the quality of the materials as well as the skill of the workmen were of the greatest importance in determining the quality of the final finish of the floor surface.

The use of quick setting cements was only advised where absolutely essential such as in under-water construction. The great heat developed by quick binding cements was said to be responsible for the trouble which so often developed with this type of material.

Where there was a possibility of beer or even sour beer coming into contact with the floor, asphalt or tiles with asphalt jointing were confidently recommended.

They had no practical experience of the construction of floors for beer cellars.

SCHEDULE OF DOCUMENTS

Versuchs - und Lehranstalt fuer Brauerei.

Schematic Drawing Muegerdarre D.R.P.
Blueprint Muegerdarre No. 118.
Chart of Temperature Recorder for Mueger Kiln.
V. L. B. Handbook.

Anton Steinecker Malzmaschinenfabrik A.G.

Drawings Nos. l, 2, 3, 4, 5, 6. Gruenmalzwender.
Patent Maa Schustex.

Carl Prandtl.

General Loose Leaf Catalogue.
Four sketches of Yeast Washing Plant and apparatus.

M.I.A.G.

Loose leaf Catalogue - Malting Machinery
Hand Book for the Miller.

J.A. Topf and Söhne, Erfurt.

Leaflet E.14l. - Topf Pneumatic Box Kiln.

Prof. Dr. Jng Fischer - successor to Prof. Th. Ganzenmüller Freising, Weihenstephan.

Plans of a Malting.
Drawings Nos. 2334 to 2342 inclusive.

The above documents have been lodged with Technical Information & Documents Unit, German Division, Board of Trade, 40.Cadogan Square, London. S.W.1.

Applications to inspect these documents should be made to this address quoting the following BIOS Reference no. BIOS/DOCS/2420/3352.

APPENDIX A.

STAFF OF THE VERSUCHS-UND LEHRANSTALT FUER BRAUEREI, BERLIN.

Dr. Antehnann. Berlin-Frohnau. Wahnfriedstrasse. 27.	In the Army till 1944. Now active as outside Consultant, and particularly in the field of malting.
Professor Dr. Bausch. Berlin-Niederschoenha, usen, Grabbeallee, 46.	In the Army till 1940. Active ever since as Lecturer on Brewing and Chemical Analysis and also on Materials and Chemical-technology in the School of Economics.
Dipl.Br.Ing Broehl. Berlin-Wiltnesdorf. Wittelsbaherstrasse, 36.	In the Army till 1946. Scientific Officer in the Brewing Machinery Section of the Institute at present.
Redakteur Borkenhagen. Berlin-Lichtenrade. Kruegerstrasse,33.	Newly appointed to the Institute Staff as Editor of the “Tagezeitung fuer Brauerei”.
Professor Dr. Drews. Berlin-Frohnau. Yeast Manufacture Alemannenstrasse. 78.	Head of the Section of the Institute covering and Grain Alcohol Distilleries and Lecturer

	at Berlin University during the War. Now Head of the whole Institute.
Dr. Haehn. Falkensee Bei Berlin. Kaulbachstrasse. 5.	Active throughout the war on Biochemical investigations. Active now in the same field, with particular reference to the development of non-alcoholic and substitute drinks.
Professor Dr. Koch. Kleinmachnow. Grasweg. 29.	In the Navy till 1940. Head of end Lecturer in the section dealing with Microbiology.
Dipl.Ing.Kolbacl. Hohen-Neudorf Bei Berlin. Annemariestrasse.l8.	Active throughout the war as Head of the Brewing Section of the Institute as well as Editor of “Wochenschrift fuer Brauerei”. Also lecturer on Brewing. Following the same activities now.
Dr. Pauly. Berlin-Hermsdorf. Boumannstrasse.l0.	Active throughout the War as outside Technical Consultant on Brewing Technology and Plant Control. Continuing in the same activities now.
Dr. Silbereisen. Berlin-Frohnau. Am Rosenanger. 36.	In the Army till 1945. Now engaged as a Scientific Officer in the Central Laboratory of the Institute.
Dipl. Ing. Vinz. Potsdam-Babelsberg 2 Ufastrasse. 96.	Active throughout the War as Scientific Officer in Institute for Brewing Machinery and Power Plants, and at present so employed.
Dr. Vogl. Berlin-Hohen-neuendorf. Hertastrasse. 2.	Scientific officer for water, effluents and non-alcoholic drinks. Lecturer an these subjects throughout the War and continuing on the same work.
Dr. Weber. Berlin-Charlottenburg. 9. Bredtschneiderstrasse, 14.	Head of the High School Brewery throughout the war. Outside Consultant on Brewing. Lecturer on Brewing. Continuing in these activities.

APPENDIX B.

<u>EXTRACT TRANSLATED FROM THE STATUTES OF THE EXPERIMENTAL AND TEACHING INSTITUTE FOR BREWING IN BERLIN.</u>

Section One - Name, Situation. Financial Year.

The Association formed in 1883 shall be known in future as “The Experimental and Teaching Institute for Brewing in Berlin”, with headquarters also in Berlin.

Section Three - Membership.

Members in the following classes shall have voting powers:-

Brewery; active or former Brewery.
Owner; Brewery Director; Brewer;
Brewery Engineer; Maltsters;
Maltings Director; Maltings;
Director of Brewery or Maltings Laboratory.
Other persons may become Members of the Institute but shall have no voting rights.

Notice of application for membership is not necessary, and admission to membership is granted by the Chairman of the Institute following formal application.

Membership ceases:-

(a) On the death of the member,
(b) On receipt of letter of resignation sent to the Director

by registered post which must reach the Directorate not later than August lst, otherwise the subscription for the following Financial Year must be paid.
(c) By decision of the Chairman on consideration of a recommendation of the Advisory Committee.

The Chairman has the power to nominate Honorary Members following a report from the Advisory Committee.

Section Four - Subscriptions.

Subscriptions for Breweries shall be as follows:-

Up to 30,000 hectolitres (18,000 Brls.) per annum,
0.3 Reichpfennigs per hectolitre.
From 30,000 to 60,000 hectolitres (37,000 Hrls,) p.a.,
0.4 Reichpfennigs per hectolitre.
From 60,000 to 120,000 hectolitres (73,000 Brls.)p.a.,
0.6 Reichpfennigs per hectolitre.
From 120,000 to 250,000 hectolitres (153,000 Brls.) p.a.,
0.8 Reichpfennigs per hectolitre.
Over 250,000 hectolitres (153,000 Brls.) p.a.,
1.0 Reichpfennigs per hectolitre.

When computing subscriptions only complete units of heotolitres (611 Brls.) are counted.

The subscriptions for Maltings shall be as follows:-

Up to 10,000 cwte. per annum
75 Reichmarks
From to 10,000 cwts. 20,000 cwts. per annum
100 Reichmarks
From to 20,000 cwts. 50,000 cwts. per annum
125 Reichmarks
From 50,000 cwts. to 100,000 cwts. per annum
150 Reichmarks
Over 100,000 cwts. per annum
200 Reichmarks

In these two classes the minimum subscription shall be Rm. 75.

Brewers, Maltsters, Brewery Engineers - as well as retired members of the Brewing and Malting Trades - shall pay a yearly subscription of Rn.18.

Hop Merchants, Brewers Engineers, and other interested parties shall pay a minimum yearly subscription of Rn.100.

Foreign members, either as individuals or as concerns, shall pay a subscription as agreed at the time they become members.

Breweries and Maltings undertake at the commencement of each Quarter to communicate their sales for the previous Quarter, and at the commencement of each new Financial Year to communicate the corresponding figures for the whole year. In the case of Breweries, the sales shall be given in hectolitres, and in the case of Maltings, in hundredweights.

Subscriptions shall be paid Quarterly, not later than the fifteenth day of the first month of the Quarter. The Chairman is empowered, on receipt of recommendations by the Advisory Committee, to add surcharges to the subscriptions, not exceeding 100%, if the financial position necessitates such a step.

Section Ten.

The Constitution of the Institute of Fermentology and Starch Production shall hold good for the general organisation and operation of this Institute. The work carried out in this Institute shall be published in "Tageszeitung fuer Brauerei", "Wochenschrift fuer Brauerei", as well as in the Institute's own Year Book. Members have the right to make use of all findings of the Institute. Individual members whose concerns are not also members of the Institute have no right to the reduced fees charged to members for analyses and investigations.

APPENDIX C.

<u>TRANSLATION OF AN ABSTRACT OF A FULL REPORT ON THE USE OF FORCED MALT BY H. FINK.</u>

The word "forced" in this context means Malt heaped and allowed to heat for one to two days at the end of flooring which gives high sugars and amino-acids and consequently very high colour on the kiln.

In this communication the work carried out by H. Fink during 1932/1933 in conjunction with Dr. H. Reidt, C.

Dax, and R. Lechner on the subject of forced malts, is briefly catalogued. In comparative experiments portions of the same barley were malted to produce a normal dark Munich type malt and a dark forced malt. The influence of different kilning conditions on the forced malt was also investigated. The resultant forced malts were mashed alone and also blended with control malts, and the resultant beers critically compared. Technical data were collected at all important stages of both the malting and brewing processes, and communicated to the Scientific Station for Brewing, in order to study the results from the enzymatic viewpoint. The results of this work - of considerable scope - dealing with forced malts from the barley to the finished beer, have been detailed in our earlier publications and will, therefore, not be referred to here. Our conclusions on beers brewed from forced malts and our general opinion of such malts, is set out in what follows.

The forced malt beers were sampled by dozens of knowledgeable beer drinkers, as well as expert tasters., and aroused considerable interest in Munich brewing circles. Immediately after bottling, the forced malt beers were remarkable for their fullness and roundness of flavour, nevertheless, they were neither too soft nor were they lacking in "bite". They gave the impression of a higher extract than they actually possessed, and, by the uninitiated, were mistaken for "Bock" beers. The control beer did not evoke the same enthusiasm, and in comparison appeared to be another type of beer altogether. When stored in bottle for appreciable periods, the forced beer lost a great deal of its character, and certainly at a much more rapid rate than one was entitled to expect in a good quality beer. The initial balance of flavour and palate fullness disappeared. There developed a blend of a sweetish caramel flavour and an unpleasant bitter taste which lingered on the palate and rendered the beer no longer desirable. It was not possible to determine whether this great change in flavour was due to the development of sarcina or to some process similar to that which gives rise to the "old-baked" flavour on bread. The greatest disadvantage was the very high sensitivity of the forced malt beers to sarcina infection. Forcing tray observations gave clear indication of this possibility, and we anticipated a short life in bottle. All samples under observation for keeping qualities threw a deposit within ten or eleven days, whereas the control beers were entirely satisfactory in this respect.

This defect did not appear in those beers which were brewed from a blend of forced malt (the coloured malt addition to the normal malt being reduced in accordance with the amount of forced malt used). These beers had normal keeping qualities and showed no specific sensitivity to sarcina infection.

Opinions on the flavour varied considerably. Generally, however, beers brewed with the addition of 10% coloured malt to the normal malt were placed first, followed by the beers brewed only from the control malt, and finally, the beers containing up to 25% of the forced malt. None of these three beers could be described as bad. They all carried a good head with good head retention. These qualities were possibly a shade better on the normal beers, but the quality of the head was undoubtedly improved as the percentage of forced malt in the grist increased. The question as to whether dark Munich type beers are most satisfactorily prepared with the aid of coloured malt or forced malt, can best be answered by stating that both will give the desired result. Whilst the exclusive use of a forced malt cannot be recommended, its use as a blend with good quality dark Munich malt for the production of special dark beers or Bock beers, can be regarded as excellent brewing practice. Used thus, forced malt will produce sound and satisfactory beers, and at the same time the proportion of coloured malt in the grist may be reduced, or indeed discontinued altogether. There is no reason to depart from the traditional methods of brewing Munich type beers. In recent times too much importance may have been attached to the use of coloured malts, or, on the other hand, the danger of such malts proving detrimental to the beer has been grossly exaggerated. Both extremes of opinion are without justification. An experimental brew with 5% debittered coloured malt in the grist proved that first class beers can be brewed from such special malts.

Fink has also dealt with other matters regarding the use of forced malts, such as:-

The determination of grist composition for dark beers when a proportion of the coloured malt is replaced by forced malt.

The relative proportions of forced malt, normal malt. and coloured malt to produce a beer of the same colour as that brewed normally.

Both these questions are easily answered on the basis of a Laboratory mashing experiment, and the use of the formula given in the reports.

Shortly after the publication of this work on forced malts, E. Jalowetz published work confirming these conclusions, and expressing the opinion that there was no universal method for the production of malts. He also stated that forcing could be applied not only to Bavarian or Munich type malts, but also to other types, ranging from Pilsner to coffee malts. He was also of the opinion that this process had been, and still is, used in Pilsen. He further stated that the Head Brewer is a Bavarian, and had taken the process with him to Czechoslovakia, and there introduced it. According to Jalowetz, the results of forcing depend on the mode of working the floors - i. e. whether with cold or warm forcing, length of time forcing etc.

A similar process - adjusted to suit the character of the local beers - is customarily used in Vienna. In general we agree with Jalowetz's conclusions, particularly as he regards the malts we produced with a colour of 5-7 N/10 iodine (60/85° Lovibond) as special malts rather than typical Bavarian or Munich malts. As Jalowetz states, it is obvious that other methods would have to be used for normal coloured Munich type malts. This was not taken into consideration in our studies, which were specifically concerned with the production of a malt with a high degree of colour. Jalowetz, who has considerable experience in this field, has limited his remarks to statements of a general nature.

Landspersky has reported on his observations of the malt forcing system in two plants. In one case an eight to nine days old malt was sprayed some 24 hours prior to clearing from the floor and kilning. It was drawn up into heaps after spraying and left for 24 hours. At the end of forcing the extract was slightly slimy in character. After the 24 hours the heaps were again sprayed, or alternatively, sprayed after spreading on the kiln. Kilning occupied two periods of 24 hours, using air temperatures of 178°F. (65° Reaumur) under the floor. Such malts always showed some 'Hussaren' formation (e.g. measured by acrospire growth, 12 corns over 1/1, 14 up to 1/1, 54 up to 3/4) saccharification was normal (12 to 15 minutes) and colour over a series of kilnings ranged from 1.2 to 1.8 ml N/10 Iodine solution (approx. 18/22 Lovibond). On cutting there were very few steely or half steely corns, but brownish or yellowish corns were frequent. The malts so prepared were mashed in a grist containing normal light malts with small additions of caramel malt and black malt. The finished beers were entirely satisfactory both as regards colour and flavour. In another case the malt was drawn up into heaps 24 hours before clearing the floor and the temperature allowed to rise to 160°F. (60° Reaumur). Kilning was performed at 201°F. (75° Reaumur). Saccharification was still good (15 to 20 minutes) and the malt had a colour equivalent to 2 ml. N/10 Iodine solution (approx. 25° Lovibond). In this case also there were no difficulties in mashing, and the resultant beer was entirely satisfactory. It is not advisable to brew from forced malt alone, as the resultant beers exhibit a completely different character, being entirely lacking in flavour and developing other abnormal qualities.

Landspersky also refers to the observations of H. Fink and F. Emslander on the sensitivity of beers made from forced malt, to sarcina infection. Emslander traces this back to the very low ratio of sugar: non-sugar extract (100:90) in the worts. He also refers to the experiments of H. Fink which showed that beers made from a blend of 10% forced malt with 90% normal Bavarian malt did not exhibit this defect but had normal keeping qualities, no noticeable tendency to sarcina infection, normal head and head retention, and a full round flavour which satisfied the public taste.

Publications referred to are:

2. Band "Dae Maelzen" pp. 77, 106, 151, 223. Berlin 1932.
Wochenschrift f. Brauerei 1933, pp. 397, 405, 413.
Landspereky, Der Boehmieches Brauerei 1935. Vol.1.pp.3.
Wochenschrift f. Brauerei 1933. pp.326.
Wochenschrift f. Brauerei. 1934. pp.93.
Die Brau - und Malzindustrie. 1934. No.1.pp.1.
Der Boehmisches Bierbrauer. l935. Vol.1.pp.3.
Wochenschrift fur Brauerei. 1933. pp.109

APPENDIX D.

PROCESS FOR THE CLEANING AND STERILISING OF FILTER PULP BY DR. PAULY.

(Translation from the German Publication.)

D.R.P. 688922.

Target:	Pulp Washing. V.L.B.
Location:	Berlin-nord 15. Seestrasse 15.
Type:	Research Institute for Brewing.
Date:	15th July, 1946.

Persons Interviewed: Dr. Pauly.

The process patented by the V.L.B., under German Patent No, 688922 was dependent on the use of calcium hypo-chlorite and carbon dioxide for the regeneration of an exhausted and unusable filter pulp, and brought this regeneration about in the simplest and cheapest manner. Further, using minimum quantities of these two chemicals, the process could also be used in normal pulp washing to very great advantage.

The calcium hypo-chlorite was a cheap chemical produced in large quantities by the heavy chemical trades, and carbon dioxide was obviously available in any brewery, so the question of the necessary raw materials presented no difficulty. The fundamental principle underlying the process was the fact that when carbon dioxide reacted with calcium hypo-chlorite, it formed nascent oxygen and chlorine. When carbon dioxide acts on a suspension of filter pulp in water to which calcium hypo-chlorite had been added, the effect was simultaneously oxidising and chlorinating. Quite apart from the resultant disinfectant and bleaching effects, the passage of the fine bubbles of carbon dioxide through the suspended pulp brought about a general loosening of the pulp mass. Thus, three effects were obtained in one operation - i.e. disinfection, bleaching, and disintegration. The insoluble calcium carbonate formed by the reaction of the carbon dioxide with the calcium hypochlorite was converted to soluble calcium bicarbonate by the excess carbon dioxide gas, and was washed out so that there were no undesirable residues of an insoluble character to hinder the general washing processes. With this process it was possible to obtain, in a short period and at low treatment temperatures, a filter pulp ready for use that fulfilled the highest requirements as to cleanliness, efficiency of filtration, and biological properties. Exhaustive tests had shown that an effective concentration of 0.01 to 0.04% chlorine calculated on the total volume of fluid in the pulp washer was adequate to achieve practical sterility. The method outlined had shown itself to be the best possible and was in operation in a number of breweries. According to the degree of dirtiness, the filter pulp was given a preliminary wash with continuous circulation for 30 to 60 minutes, the temperature gradually rising to 86 to 104°F. (30 to 40°C.) during this period. The pulp was then cooled to 50 to 59°F (10 to 15°C.) by running in cold water. Through a special connection on the washer side of the circulating pump carbon dioxide was introduced into the washer from a cylinder of the gas at a pressure of 15 to 22 lbs. per square inch.

For adequate dispersal of the gas it was advisable to have a rose fitted on the carbon dioxide connection at the bottom of the washer, although this was not essential if only experimental treatments were involved. Addition of the necessary amount of calcium hypochlorite commenced as soon as bubbles of carbon dioxide could be seer. on the surface of the suspension. To prevent lumping the calcium hypo-chlorite should be mixed up to a paste with water before adding to the suspension. The washing water should be shut off before the calcium hypo-chlorite paste was added, but the circulating pump must be kept in operation. The period of treatment should, not exceed 30 minutes, and with a pulp that was not too dirty, it could be appreciably reduced.

At the end of the reaction period the carbon dioxide was shut off, and the after-washing with cold water commenced. After-washing continued for one hour, at the end of which time the pulp was ready for making up into cakes. Pulp treated by this method was thoroughly and effectively disintegrated and looked like a new pulp. Filters set up with pulp so treated indicated normal pressure drops, and frequently lower than normal pressure drops. Numerous biological examinations had been made on pulps washed in this manner in various breweries, which, without exception, had given good results. The pulps could be classified as practically sterile. No instance had come to light of any damage to the pulp fibres. The slight chlorine smell which clung to the washed pulp had no influence on the taste of the beer under filtration, as had been shown by critical examination. Further, samples of pulp were taken immediately after completion of chlorination and prior to after-washing, shaken with beer, and the beer then filtered off and tasted. This was, of course, a very drastic procedure, introducing conditions that would never occur in practice. No influence whatsoever could be detected on the taste. Finally, it had been shown that the considerable reduction in the mechanical strain placed on the pulp through reduced treatment time as compared with normal treatment methods, brought about an increase in the life of the pulp of the order of 20 to 30%.

Assuming an effective chlorine content of 30 to 35%, then treatment with 5 kilogrammes per 100 hectolitres 2.89 ozs, per brl.) of total liquid in the pulp washer normally sufficed for the regeneration of a pulp. It was not intended to make the process too complicated, particularly for Bottling Stores having no control laboratory of their own, and these figures will serve as a sufficient and adequate guide for carrying out the process.

The details given apply to the regeneration of an exhausted pulp. Should the process be used continually for washing and sterilising pulp, the reaction quantities could be appreciably reduced, and yet a pulp, fulfilling all requirements, would nevertheless be obtained.

This description indicated that when compared with normal methods, the process had considerable advantages in relation to the life of the pulp, the necessary requirements in terms of time and power, and the virtue of extreme simplicity.

The foregoing theoretical considerations were published in “Wochenscrift fur Brauerei” No. 49, 1940, under the title “Ein Neues Verfahren zue Behandlung von Brauereifiltermassen”. It also formed the theme of a paper at the January Meeting., 1941, of the V.L.B., reported in “Allgemeinen Braumeister-Zeitung”.

APPENDIX E.

A STUDY OF INFECTION IN LOW GRAVITY BEERS

Translated and condensed from a summary supplied by Professor H. Schnegg. No figures are given but the study probably concerns bears of 1020° to 1006°O.G. To obtain reliable results suitable culture methods must be employed. These include:-

(a) Yeast water is not entirely satisfactory as medium for cultivating infections in low gravity worts and beers, as the growth of fluorescent and other bacteria will often suppress the beer bacteria.

(b) Consequently wort or beer should be employed as the basis of the culture medium and the strength must be the same as that to be investigated, as the bacteria to be studied (e.g. B. subtilis) are suppressed at higher concentrations.

(c) If dilution with equal volumes of water is practised in the brewery then the same proportion should be used for inoculating the cultures.

(d) Incubation of cultures should be carried out at two temperatures:-

(i) at forcing tray temperature
(ii) at fermenting cellar temperature

as the two temperatures bring to light different types of infection.

Using these methods the following findings were obtained:

1. The lower the original gravity of the worts or beers the more liable they are to infection.

2. Low gravity beers are more liable to infection than the corresponding worts. Three factors probably account for this; (a) when below l% the alcohol probably serves as a stimulant to the infecting organisms, (b) the pH of the beers is higher than that of the worts (c) the products of yeast autolysis which are plentiful in weak beer are also favourable to the development of infection.

3. B. subtilis was frequently found but often in atypical forms. Instead of the usual motile and thread forms, it was often found as short rode simulating the thermo-bacteria (but differentiated by the absence of the characteristic smell associated with these) or as long rods simulating lactic bacteria.

4. If the water used for diluting beer is boiled to sterilise it, it so readily becomes infected from mains etc. during the subsequent cooling that (unless badly contaminated) it is better to use mains water rather than boiled water.

5. For badly contaminated water, chlorination is the best treatment. The few bacteria remaining alive are too weakened to do any harm.

6. From the bacteriological standpoint it is best to dilute the beers in the fermenting vessels at the height of fermentation. (This is also the time found best by other observers for obtaining beer with a satisfactory degree of fermentation and a satisfactory carbon dioxide content.)

APPENDIX F.

THE PROBLEM OF PRODUCING NON-ALCOHOLIC BEER

Translated and condensed from a communication by Prof. H. Schnegg.

The Weihenstephan and other research institutes had been ordered to produce a non-alcoholic beverage which was satisfactory from the point of view of taste, purity and dietetic value.

The quantity required was of the order of 15 to 18 million barrels per year. Schnegg concluded that the total output of the drinks suggested by other workers derived from whey, or sugar beet or the special "Ludwig" beer and other similar beverages which relied upon unusual yeasts or other organisms would fall a long way short of the estimated target. Furthermore these drinks would be too expensive, and if produced in existing breweries they would not only be very liable to become infected with the normal brewery yeast, but on account of their weak fermenting capacity, they would be open to serious and rapid infection by moulds and bacteria. The plant necessary to produce such beverages in the required volume was only to be found in existing breweries, and many of the breweries did not possess the laboratory facilities which would be essential when cultures of special organisms were in use.

Consequently Schnegg concluded that the non-alcoholic drink must be founded on normal beer brewing methods, and he proceeded to discuss the possibilities in this direction and his own findings and those of his colleagues at the Weihenstephan Experimental Station. It was first necessary to comply with the law that non-alcoholic drinks shall not contain more than 0.5% of alcohol and he thought it possible to produce such a drink which would be both satisfactory to lemonade drinkers and others, if not entirely satisfactory to critical beer drinkers. Although in agreement with the V.L.B., workers he was of opinion that, if the limitation of alcohol could be raised to not more than 0.6% of alcohol, a distinctly better flavour could be obtained.

Unsuccessful attempts had been made to interrupt the fermentation of wort when it contained less than 0.5% of alcohol but it had been found impossible to check at this stage. Again investigations had been made on the removal of alcohol., in excess of the limits from fully fermented wort by boiling. This method, however, proved both uneconomic and undesirable in as much as the volatile flavours were unfortunately removed along with the alcohol.

Beers of an original gravity low enough to yield less than 0.5% of alcohol were deficient in dietetic value and lacking in flavour. In consequence the non-alcoholic drink would be beat prepared by mixing a fully fermented normal beer with unfermented wort. Un-hopped wort conferred a mawkish sickly sweet flavour, while hopped wort imparted a bitter gall-like flavour. This latter flavour, however, could be removed by absorption, and activated charcoal in suitably adjusted quantities was found most satisfactory for this purpose. It was also ascertained that dilution of the wort from the normal brewing gravity of 1038° to 1040° specific gravity to about 1024° specific gravity was very beneficial. A blend was therefore proposed, consisting of normal well attenuated filtered beer of 1038° - 1040°O.G. with wort of 1024 specific gravity after treatment with charcoal. The charcoal could be removed from the wort by filtration soon after addition as the absorption was rapid. Alternatively, the charcoal could remain in the wort while the wort and beer were mixed in the carbonating tank, and it could be removed from the blend during filtration prior to bottling or racking into cask.

Such non-alcoholic beer, although only filtered through pulp, showed remarkable biological stability and little tendency to chill haze, and in consequence pasteurization or other treatment did not appear necessary.

The north Germans prefer a flavour sweeter than that acceptable to the south Germans. It was possible to obtain a range of flavours by using different hop rates, by employing hard or soft water for dilution, by altering the proportions of activated charcoal for absorption and by varying the type of beer used in the blend. Improved flavour could be secured by acidification, but by German law this could only be carried through biologically and Schnegg regarded such procedure as too troublesome.

Schnegg claimed that the method outlined for producing a non-alcoholic beverage satisfied all the requirements laid down and on the difficult question of flavour provided the beat solution so far, though further experiments on this aspect were planned for the future.